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Victorian Basalt Plains grasslands – an overview

Grassland restoration in the south east of South Australia

Keeping your options open – optimal fire frequencies in *Themeda-Poa* ecosystems

Storing tubers of Milkmaids (*Burchardia umbellata*)

Conservation of Monaro Golden Daisy habitat

And much much more.....

SPECIAL THEME: GRASSLANDS AND GRASSY ECOSYSTEMS

This issue

Regular Features

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Australasian Plant Conservation is a forum for information exchange for all those involved in plant conservation: please use it to share your work with others. Articles, information snippets, details of new publications or research, and diary dates are welcome. **The deadline for the March - May 2007 issue is Friday 2 March 2007.** The March-May issue will be on the special theme of 'Soil biota in native vegetation health and management'. However, general articles are also very welcome. Please contact Tom May if you are intending to submit an article: tom.may@rbg.vic.gov.au.

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Front cover: A high quality grassland remnant occurring at the Rokewood Cemetery, Victoria, with exotic pine trees in background.
Photo: Paul Gibson Roy.
Cover design: Siobhan Duffy.
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From the Editor: introducing 'Grasslands and Grassy Ecosystems'

Tom May

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The focus of this issue of *Australasian Plant Conservation* is grasslands and grassy ecosystems. Across Australia these are severely reduced and fragmented. The ANPC has been active in promoting grassland conservation, such as through the recent 'From the ground up' workshop on conservation and rehabilitation of grassy ecosystems in the ACT region (see report by Sally Stephens). Generous sponsorship for the production of this issue of APC was received from the Department of the Environment and Heritage. Many grassy vegetation types are listed under state and federal conservation and biodiversity legislation.

Paul Gibson Roy and John Delpratt provide an overview of the temperate grasslands of the Victorian Basalt Plains. These grasslands have suffered the typical post-European decline in extent and quality. The authors describe current efforts in conservation and restoration such as use of direct seeding in reintroduction of species-rich grassland on bare-field sites. An initiative that aids grassland conservation on private land is the Victorian Volcanic Plains Tender scheme (VPP). Anne Buchan explains the tender process, which includes evaluation of the conservation status of sites.

Fire is recognised as an important management tool for grasslands. Suzanne Prober and co-authors discuss a long-term scientific study of the effects of differing fire frequencies on understoreys in grassy woodlands in central New South Wales. Different sites responded differently to fire, depending on the species composition of the grassy sward. This means that a uniform recommendation cannot be made for fire frequency. Rather, knowledge of the composition of the grassy sward, along with an understanding of recent disturbance history, must inform the burning regime.

Grasslands are scarce in South Australia. Bryan Haywood and co-authors describe grassland occurrences and management at two sites in the lower south-east of South Australia. In the Northern Plains of Victoria, native grasslands are highly fragmented. Darren Bain and Deanna Marshall introduce the Victorian Northern Plains Conservation Management Network, which links land managers, promoting sharing of knowledge and co-ordination of works. In the Southern Tablelands of New South Wales and the Australian Capital Territory only 3% of grasslands remains. Greg Baines reports on the activities of the National Recovery Team for Natural Temperate Grasslands of the Southern Tablelands, which include assessment of current distribution, and provision of management guides to landowners.

Because grasslands are often highly endangered, so too are many species that are found in them. The Monaro Golden Daisy (*Rutidosis leiolepis*) is a threatened species that occurs at the Old Cooma Common Grassland Reserve. David Eddy and Geoff Robertson outline a project to conserve the habitat of the daisy, including potential use of conservation grazing as a tool to manage biomass and weeds. In South Australia, Spiny Daisy (*Acanthocladium dockeri*) is a critically endangered shrub of remnant grassland in the mid-north. Manfred Jusaitis discusses the response of the plant to fire. It is capable of rapid regeneration after fire, and burning also has potential to control snails that graze on the plants.

Rare plants often have small populations. Melinda Pickup considers management of small populations in terms of their genetic viability. A case study is presented for *Rutidosis leptorrhynchoides*, a grassland daisy with self-incompatible reproduction. She raises the possibility that keeping populations as genetically distinct entities may not always be the best strategy, and that (with careful planning) there may be benefits of translocation of genetic material ('genetic rescue').

Restoration of grasslands requires seeds. Effective direct seeding needs viable seeds. Seed viability testing of nine grassland species from the Victorian Western Plains is investigated by Marjorie Hall and co-authors. Different techniques of testing are recommended for different species, due to variation such as in the hardness of the seed coat. Milkmaids (*Burchardia umbellata*) is a

Best Wishes to ANPC President, Judy West

As many members will have heard, ANPC President Judy West underwent heart surgery in November 2006, and had been ill for a couple of months before that. Those who know Judy will be well aware what a dynamo she is in all her areas of work, including for the ANPC. Judy is now recuperating and we wish her a complete and rapid recovery, but for now we just hope she is resting and enjoying a life without meetings and deadlines for a while.

widely distributed tuberous lily of temperate Australian grasslands. Because it takes several years to grow plants of suitable size for outplanting, it is seldom available as tube stock. Jenny Bear and John Delpratt show that storage of tubers in moist vermiculite is successful, compared to dry storage. This raises the possibility of direct planting of small, dormant tubers.

Grasslands all across Australia need friends. Kim Pullen and Geoff Roberston provide an account of the past and current activities of Friends of Grasslands, a group active in conserving grasslands in south-eastern Australia. The concluding article is by Geoff Roberston, who argues that the unpaid work of volunteers is an indication of a healthy society. He suggests that volunteer codes of practice assist in valuing the work of volunteers and directing it to best effect.

The Australian Network for Plant Conservation is typical of non-profit organisations in being heavily reliant on voluntary input, and this is certainly true for the production of *Australasian Plant Conservation*. I'd like to highlight the contribution of the volunteer editors and proof readers for 2006, including: Claire Brown, Tom Celebrezze, Tricia Hogbin, Leonie Monks, Deanna Marshall, Sally Stephens, Helena Mills, Rosemary Purdie and Bob Makinson.

Wild about workshops

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The last half of 2006 was very busy with workshops. A few glimpses follow.

Ulladulla, 25-26 October
The rehabilitation and management of disturbed native plant communities

On 25-26 October, a hundred people (including one from Adelaide and two from Victoria) participated in a native vegetation rehabilitation workshop on the NSW south coast. A talk on the ecological principles underlying successful rehabilitation set people thinking, then speakers from diverse backgrounds spoke on planning, vegetation condition assessment, the role of lichen crusts and other soil organisms in vegetation health, provenance of plant material, monitoring and adaptive management, understanding stream geomorphology in foreshore rehabilitation and the importance of supporting volunteers. Case studies included the rehabilitation of a local wetland and an uplifting outline of the extensive Shoalhaven Coastal Restoration project.

Most of the second day was the demonstration and trialling of field techniques. The group was guided through the Milton Ulladulla Landcare Nursery by about 10 nursery volunteers. As well as observing propagation and other techniques, the very new and comprehensive database of Shoalhaven flora was demonstrated by its developers, Mal and Carolyn Whan. At the Narrawallee Bushcare site we broke into four groups and rotated around four activities: soil organisms and soil health, site assessment, weed assessment and management priorities, and monitoring techniques. This site is maintained by the energetic Narrawallee Bushcare Group, who battle with weeds as well as local development pressures.

Considerable excitement was generated by David Eldridge's elegant demonstration of how ants assist water to penetrate soil. Water poured into a metre-high glass cylinder placed over an insignificant depression in the sand (made by funnel ants) gurgled down in seconds. In an adjacent cylinder with no hint of ant activity, the water hardly moved. These tubes were barely half a metre apart - in the second the water puddled reluctantly on the surface, revealing that the sand was hydrophobic (water-repelling).

The final field site was Millard's Creek, a patch of remnant bush in the heart of Ulladulla, lovingly managed by the hard-working but small Millard's Creek Bushcare group. The site demonstrated what can be achieved by a committed group but also demonstrated the challenges they face and the need to attract more volunteers to work in these sites if the benefits are to be maintained.

The attendance of four community volunteers at the workshop was sponsored by the Southern Rivers Catchment Management Authority, while three were funded by the Shoalhaven City Council.

This was the first of two coastal workshops subsidised by the NSW Environmental Trust. The second workshop in this series will be held in Coffs Harbour on 14-15 March 2007.

Canberra, 28-29 November
'From the ground up': a workshop on the conservation and rehabilitation of grassy ecosystems of the ACT and region

This workshop focused on the conservation management and rehabilitation of Natural Temperate Grasslands and Box-Gum Grassy Woodlands, listed as endangered and critically endangered respectively under the EPBC Act.

Including presenters and volunteer helpers, 86 people participated in this workshop from as far away as Adelaide, Armidale, Lismore and Victoria. Presenters were largely local specialists but Paul Gibson Roy (an ANPC Committee member) came from Melbourne and Peter McGee came from Sydney. Topics covered landuse history and management strategies, rehabilitation planning, rapid soil health assessment (Landscape Function Analysis), soil microbes in grassland rehabilitation, conservation genetics, guidelines for seed collection, manipulating management such as grazing, fire and slashing, monitoring and adaptive management, and the role of volunteers. Case studies were on re-establishing complex grasslands in Victoria by direct seeding and grassland management for endangered fauna protection in Kuma Nature Reserve in the Monaro region of southern NSW.

Field activities focused on trialling components of the *Grassy Ecosystems Management Kit* produced by local grasslands specialists, most of whom were involved in this workshop. Sarah Sharp, of the ACT Government's Parks, Conservation and Lands group, was a key organiser of the field program, aided by the energetic contribution of the other field leaders.

We visited Little Mulligan's Flat and the Justice Robert Hope Reserve. At each site, the group broke into four smaller groups and rotated around four activities.

Greg Baines demonstrating techniques to assess ground layer vegetation at Little Mulligan's Flat. Photo: Jean Geue

In addition to the Management Kit activities, David Tongway demonstrated his Landscape Function Analysis technique, a highly effective method of assessing soil health. He also demonstrated a new technique for assessing drainage line erosion risk and status.

The field day was an increasingly typical Canberra spring day: hot, dry and windy. Fortunately the woodland trees provided enough shade to keep the group happily working through all the activities.

The attendance of three community volunteers at the workshop was sponsored by Natural Temperate Grasslands Recovery Team, while five were funded by Department of Environment and Heritage sponsorship.

This workshop was assisted by an ACT Environment Grant and sponsorship from the Department of Environment and Heritage.

Feedback and sponsorship

I learned a lot, confirmed a lot and made some wonderful friends and contacts. The two-way flow of information and experiences can do nothing except help our beautiful environment. (Volunteer Bushcare group coordinator and participant in Ulladulla workshop).

This workshop has been invaluable to me as a landholder and non-scientist. Very good communication of complex ideas. Will help me to understand my property and to work systematically towards a management plan. Thanks. (Private landholder and participant in Canberra Grassy Ecosystems workshop).

Feedback from both these workshops was very positive, though the evaluation forms have yet to be fully analysed. 44.7% of the Ulladulla registrants returned their evaluation forms, while 56.5% of the grasslands registrants returned theirs. The participant quotes above were just some of the enthusiastic responses we received. Some feedback also suggests other ideas and topics, though the two-day format clearly cannot encompass all desires.

Sponsorship to assist the attendance of community volunteers, such as we achieved at both these workshops, will be sought for future ANPC workshops. While our workshops provide a very generous discount for volunteers, students and pensioners, some still cannot afford to attend. Sponsorship was designed to target volunteer workers who would benefit from the workshop, contribute to it and transfer their new skills to others in their rehabilitation project. This sponsorship increases the ANPC's reach, particularly to local landholders.

Without the specialist presenters, who gave their time freely and enthusiastically, there would be no workshop. The same is true of the registrants who bring to the workshop their experience, enthusiasm and willingness to learn and to share. A huge thanks goes to all those who participated in developing these workshops and turning them into reality.

Victorian Basalt Plains grasslands – an overview

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The Basalt Plains grasslands are a sub-set of the larger south-eastern lowland temperate grasslands. They exist as fragmented remnants distributed over an area of approximately 23,000 km^2 of flat and undulating lands in the southwest of Victoria, which is 1% of their original range. They are listed under the *Victorian Flora and Fauna Guarantee Act 1988*, and occur in a region identified by the Australian Government's Threatened Species Scientific Committee in 2003 as one of 15 national biodiversity 'hotspots'.

Basalt Plains grasslands occur on soils derived from volcanic flows, and are characterised by the dominant tussock grass *Themeda triandra* (Kangaroo grass), and the sub-dominant tufting grasses *Austrodanthonia* species (Wallaby grass) and *Austrostipa* species (Spear grass), with a wide variety of forb and annual exotic species occupying the inter-tussock spaces (Fig. 1). A variety of other organisms from different trophic levels such as mosses, lichens, liverworts and algae (that form cryptogamic crusts on soil surfaces), soil inhabiting arbuscular mycorrhizal fungi, invertebrate species and a host of vertebrates, reptiles, birds and mammals, form important components of these communities and contribute to their function and stability. Along with the vascular plant component of the grasslands, these other organisms are also threatened by the many direct and indirect impacts of human activity.

Figure 1. A high quality grassland remnant occurring at the Rokewood Cemetery. Photo: Paul Gibson Roy

Post European impacts

For over 150 years European agricultural practices have had a dramatic and disruptive effect on Basalt Plains grasslands (Morgan 2001). From the 1830s, pastoralists used these grasslands for the grazing of sheep and cattle. Many of the forb species were highly palatable to stock and were subsequently grazed out of pastures and stock routes (Kirkpatrick *et al.* 1995, Lenz *et al.* 2003). Selective grazing also altered plant population densities within grassland communities (Lunt 2003). In some areas, grazing decreased the dominance of *Themeda triandra* and facilitated the competitive release of subdominant native grasses such as *Austrodanthonia* species and *Austrostipa* species and other exotic annual species. Hard-hoofed grazers also had a disruptive effect on the basalt soils, causing erosion, breaking up cryptogamic crusts and generally creating conditions favourable for the invasion of exotic weed species (Kirkpatrick *et al.* 1995, Eldridge *et al.* 2000).

After the Second World War large numbers of soldiers settled the Basalt Plains, significantly increasing the impact on native grasslands. They practised widespread cultivation, increased the use of superphosphate and introduced exotic clovers and grasses (Department of Natural Resources and Environment 2003a). The ongoing use of superphosphate and other fertilizers has continued to impact directly and indirectly on the native grasslands (Morgan 2001).

In recent years the development of new agricultural techniques and practices continues to negatively impact on remnants. For example, the implementation of raised bed cropping in areas of higher rainfall has allowed landholders to convert what may have been native pasture into areas suitable for annual cropping. Another development that threatens remnants on stony rises is a heavyweight roller that has recently become available. This crusher is attractive to some landholders as it allows them to fragment the large rocks that make stony rises 'unworkable'.

Figure 2. Construction of the F2 Hume Freeway link, November 2002. This freeway now dissects the Barry Road grassland into two, further threatening its long-term stability. Photo: Paul Gibson Roy

In addition to these agricultural effects, grassland remnants have been degraded, destroyed or are under threat from urban expansion or the construction of roads, railway lines and other types of transport infrastructure (Kirkpatrick *et al.* 1995, Morgan 2001, Williams *et al.* 2001). Indeed, several grassland sites to the immediate west and north of Melbourne have been severely degraded or destroyed in recent years by the expansion of housing developments on urban fringes and the construction of new freeways (Fig. 2) (Williams *et al.* 2001).

Conservation and restoration

Because the western plains of Victoria were among the first areas to be colonised by European settlers, very little land was acquired for public use (Kirkpatrick *et al.* 1995). There are few public parks protecting grassland or grassy woodland within the Basalt Plains region. Mount Napier State Park and the Mount Eccles National Park are two notable exceptions. Consequently, grassland remnants are primarily found along roadside reserves and railway easements, within fenced-off cemeteries and, to a limited extent, on private land (Lunt *et al.* 1998). To begin to address this situation, in 1996 the Victorian Government, with financial assistance from the Australian Government's National Reserve System scheme, began purchasing properties for grassland reservation. Prominent examples of reserves acquired under this strategy include: Cobra Killuc Wildlife Reserve, Cooper Street Grassland Reserve, Craigieburn Grassland Reserve, Derrimut Grassland Reserve and Laverton North Grassland Reserve. However, these reserves and parks are small in size and scattered over a large area, limiting their potential to protect and conserve the larger grassland community.

While government authorities have largely been responsible for initiating conservation and reservation programs, the Trust for Nature, a non-government organisation established in 1972 under the *Victorian Conservation Trust Act*, is actively involved in grassland conservation on private lands. From 1989, a revolving fund was set up by the Trust For Nature to facilitate the purchase of conservation-worthy lands. Once purchased, conservation covenants are placed upon the properties before they are re-sold. The covenants are legally binding and remain valid even after a property is sold. In recent years, Australian Government tax laws have also supported these conservation covenants (Department of Natural Resources and Environment 2003b).

The Victorian Volcanic Plains Tender scheme (VVP) is another positive initiative which will aid the conservation of grasslands on private lands. The VVP is a federally funded program supported by a number of Catchment Management Authorities. The VVP aims to support landholders to manage and conserve remnant native vegetation. It is an auction-based process where, in return for financial support, successful bidders enter management and conservation agreements with the funding authority. To date VVP contracts cover 1,608 ha of Plains Grassland, 1,032 ha of Stony Rise Woodland and 633 ha of Plains Grassy Wetland. It has also established conservation covenants over 581 ha within these areas.

There have been few reported large-scale grassland restoration projects on the Basalt Plains. At small scales, container-stock plantings are the most commonly utilized technique employed. While this method represents an efficient use of limited seed resources, it is particularly labour-intensive and potentially expensive (Hitchmough 1994). There has been little reported use of direct seeding in grassland restoration, in part because poor results from some early studies led some researchers to question this technique, but primarily due to the limitation in quantity and quality of seed supply (Gibson Roy and Delpratt 2006). The Grassy Groundcover Research Project (GGRP) was initiated in 2004 (Gibson Roy 2005). It aims to establish techniques that allow for the reintroduction of species-rich grassland onto bare-field sites (Fig. 3). The GGRP offers some hope that, in addition to ongoing conservation efforts, restorationists may be able to increase the occurrence of Basalt Plains grassland from its present perilous state.

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Figure 3. One of 13 Grassy Groundcover Research Project study sites. This one hectare site, at Werribee Zoo, shows a species-rich reintroduction twelve months following sowing. This was the first of three annual sowings. Photo: Paul Gibson Roy

VVP PlainsTender – investing in grassy ecosystem conservation on the Victorian Volcanic Plains

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Victorian Volcanic Plains

The Victorian Volcanic Plains (VVP) Bioregion is located in southwest Victoria, and stretches from Melbourne to Portland, covering 2.3 million hectares (Fig. 1). Native vegetation remains on only 4.5% of the area, with most of the remnants being on private land. These remaining areas of native grasslands, wetlands, stony rise woodlands and grassy woodlands, although fragmented, are crucial for the conservation of endemic flora and fauna. However, the VVP Bioregion is a highly productive agricultural region and the task of maintaining and developing agricultural production, while at the same time protecting and enhancing biodiversity assets, presents a significant challenge.

Historically, a range of mechanisms for native vegetation conservation on private land, including a mix of regulations, fixed-rate grant schemes and educational programs, have been employed across the VVP in an effort to encourage landholders to maintain their grassy remnants. Regulations have largely stopped broad-scale clearing, but the management of grassy remnants on private land remains an issue.

VVP PlainsTender

The Victorian Volcanic PlainsTender (VVP PlainsTender) Project was a joint initiative between Corangamite, Glenelg-Hopkins, North Central, Port Phillip and Westernport Catchment Management Authorities and the Victorian Department of Sustainability and Environment (DSE). The project was funded through the Australian Government's Natural Heritage Trust to protect and enhance remnant vegetation across the bioregion. Through VVP PlainsTender, the various agencies are implementing a range of activities and programs to (1) support landholders across the bioregion who are interested in conserving native vegetation on their land, and (2) encourage others to adopt similar ecologically sustainable practices. A major component of the project is a stewardship payment scheme to support landholders in the conservation and management of native vegetation on private land.

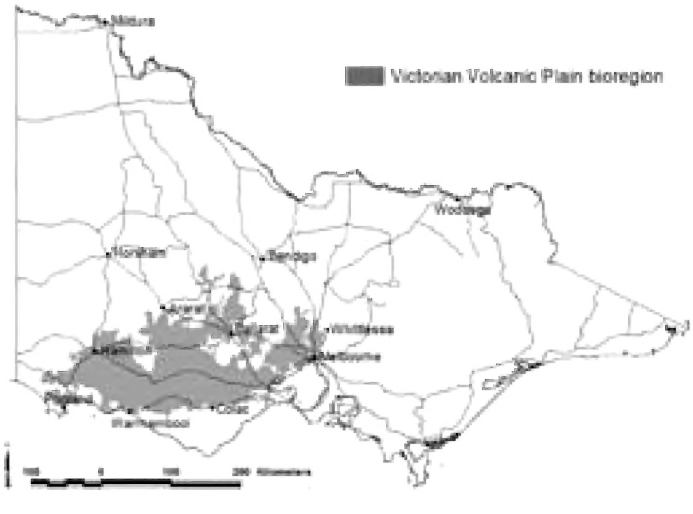

Figure 1: Map of the Victorian Volcanic Plains.

In an effort to better target high priority sites and to enable the establishment of fair and equitable cost-sharing arrangements, VVP PlainsTender adopted a Market Based Instrument (MBI), whereby contracts were purchased through a competitive single-bid tender process based on DSE's successful BushTender approach. Two rounds of the tender were conducted, the first in Spring 2004 and the second in Spring 2005.

More than 125 landholders registered an Expression of Interest with the program, and each received an obligation-free site assessment. Over the two rounds of tenders, field officers assessed 320 grassy remnants totalling 7,918 hectares and encompassing 23 different Ecological Vegetation Classes (EVCs) including wetlands, woodlands and grasslands (Buchan 2006). A management plan for each site was developed through discussions between the landholder and the field officer, taking into account the characteristics of the site, the threats to its conservation values and the landholder's vision for the management and restoration of the site.

Bids were ranked in order of value for money by an objective measure which included the landholder bid, current site conservation value and amount of service offered (the Biodiversity Benefits Index (BBI)).

The conservation value of the site was determined on the basis of the type, status and quality of the native vegetation present, the occurrence and status of flora and fauna species likely to be present and the position of the site with respect to broader landscape requirements for key mobile fauna species. Agreed landholder management commitments were converted to a points score

known as the Habitat Services Score (HSS). The HSS was based on the predicted gain in quality arising from the contracted management activities (in this case 4 years of activity), improved security (through a covenant) and the total area of the site. When the management plan for a site was prepared, it was sent to the landholder along with the associated HSS and information on the site's conservation value.

Following receipt of the management plan, each landholder was invited to submit a bid nominating their price for the provision of these services for the period of the agreement. Successful landholders were offered the opportunity to sign final management agreements and these landholders received periodic payments subject to reporting and satisfactory performance against their management commitments.

There was a very high acceptance rate of offered agreements, with 94% of offers accepted. Four-year management agreements were signed with 54 landholders, to manage 4,380 hectares of land across the VVP for biodiversity and conservation (See Table 1). Landholders agreed to a number of commitments and actions to maintain and improve the quality of the vegetation including fencing and stock control, as well as control of environmental weeds and pest animals.

Table 1. Summary of PlainsTender results

	Round One	Round Two	Total
Number of bids received	59	101	
Number of successful bids (percentage)	43 (73%)	65 (65%)	108
Number of landholders who submitted bids	27	54	
Number of successful landholders (percentage)	21 (78%)	37 (69%)	54
Number of hectares under contract	2,457	1,923	4,380
Total committed	$1,009,012	$1,261,330	$2,262,505

Landholders have completed the first year of their agreements, and most have fulfilled their management commitments to date. Based on results of the BushTender trial, where over the three year period of their contracts between 84% and 94% of landholders satisfactorily completed their commitments each year (DSE 2006), it is anticipated that landholders in VVP PlainsTender will continue their high level of compliance with the agreements over the next three years.

Twenty-two different EVCs are covered by these agreements, all but three of which are classed as vulnerable or endangered. The major proportion of services are to be carried out on Plains Grassland (1,608 ha), Stony Rise Woodland (1,032 ha) and Plains Grassy Wetland (633 ha). Landholders will permanently protect 580 hectares of native vegetation covering 11 different EVCs through an on-title covenant.

Conclusions

Programs such as VVP PlainsTender can form a key extension tool to assist with promoting the conservation and management of native vegetation and biodiversity on private land. The structured one-on-one site visit provided ideal opportunities for landholders to discuss their specific sites, issues, experiences and exciting finds. They received high quality feedback on the conservation value of their site and current activities and were provided with ideas of how they could maintain or improve the site through management. Some landholders participated in the program to receive the site visit rather than to receive any financial assistance!

While the tender process appears complex and requires careful planning, there are many advantages including the creation of a fair and equitable partnership between the government and the landholder, the ability to select projects based on best value for money and the ability to finalise agreements easily. In addition, the site assessments can provide improved native vegetation and biodiversity information which can be used to update existing data.

For further details on VVP PlainsTender visit the Corangamite CMA website:
http://www.ccma.vic.gov.au/home/vicvolcanicplains.htm.

For information on other conservation tenders in Victoria visit the DSE website:
http://www.dse.vic.gov.au/nativevegetation.

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Keeping your options open – optimal fire frequencies in *Themeda-Poa* ecosystems

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Fire is widely recognised as an important process for maintaining plant diversity and productivity in temperate grasslands and grassy woodlands. Lack of fire can lead to the build-up of a thick layer of plant litter, suppressing wildflowers and other plants, and even leading to death of the dominant grass tussocks and subsequent invasion by weeds (Lunt and Morgan 2002).

Temperate lowland grasslands and grassy woodlands dominated by Kangaroo Grass (*Themeda triandra,* hereafter *Themeda*) and Snow Tussock (*Poa sieberiana,* hereafter *Poa*) were once widespread and common in the wetter (>550 mm rainfall) parts of the wheat-sheep belt of south-eastern Australia (Prober and Thiele 2005). These ecosystems have become highly threatened through intensive agricultural development, and an understanding of their response to disturbances is critical for guiding conservation and restoration efforts (Lunt and Morgan 2002; Prober and Thiele 2005). Fire is thought to have been an important form of disturbance in *Themeda* ecosystems prior to European settlement, and is a practical management tool for their conservation and restoration today. However, aboriginal burning regimes are poorly documented, and limited information on appropriate fire regimes is available to inform land managers. Opportunistic studies of *Themeda* grasslands on the fertile basalt plains in Victoria have indicated that very frequent (1-2 year) burning is essential for maintaining sward vigour and diversity, but the relevance of these observations to other regions is not known (Lunt and Morgan 2002).

Over the past 12 years, we have monitored the response of grassy understoreys to differing fire frequencies at two high quality remnants of grassy White Box (*Eucalyptus albens*) and Yellow Box (*Eucalyptus melliodora*) woodlands near Cowra in central New South Wales (Fig. 1). Both remnants (Monteagle and Woodstock) have few weeds and a high diversity of native herbaceous plants among the dominant *Themeda* and *Poa* tussocks. Monteagle has a history of frequent burning, while Woodstock has remained unburnt for at least 60 years. In 1993, we established replicated plots at each site and applied autumn burns at either 2, 4 or 8 year intervals, and left some plots unburnt.

Figure 1. Experimental plots at Woodstock (top) and Monteagle (bottom) near Cowra, NSW. Photos: Suzanne Prober and KevinThiele

Effects of fire frequency on sward composition and vigour

Fire frequency dramatically affected the abundance of the dominant grass species in *Themeda-Poa* understoreys. These results have important implications for the resilience of the native understorey to future disturbances, including future fire regimes.

At Monteagle, cessation of burning led to a steady increase in the abundance of *Poa* (Fig. 2), while on frequently burnt plots, *Themeda* remained dominant. By contrast with Victorian *Themeda* grasslands (McDougall 1989; Lunt and Morgan 1999; Morgan and Lunt 1999), there was little evidence for long-term decline or mortality in the grassy sward due to lack of disturbance. This striking contrast with Victorian studies could be due to a number of factors, including lower productivity at Monteagle compared with the Victorian basalt grasslands, and the presence of *Poa* in our swards. *Poa* is sparse or absent from *Themeda* grasslands in Victoria, and thus *Themeda* decline cannot be compensated by an increase in *Poa* in Victorian grasslands. As well, drought conditions in 2003 caused a temporary

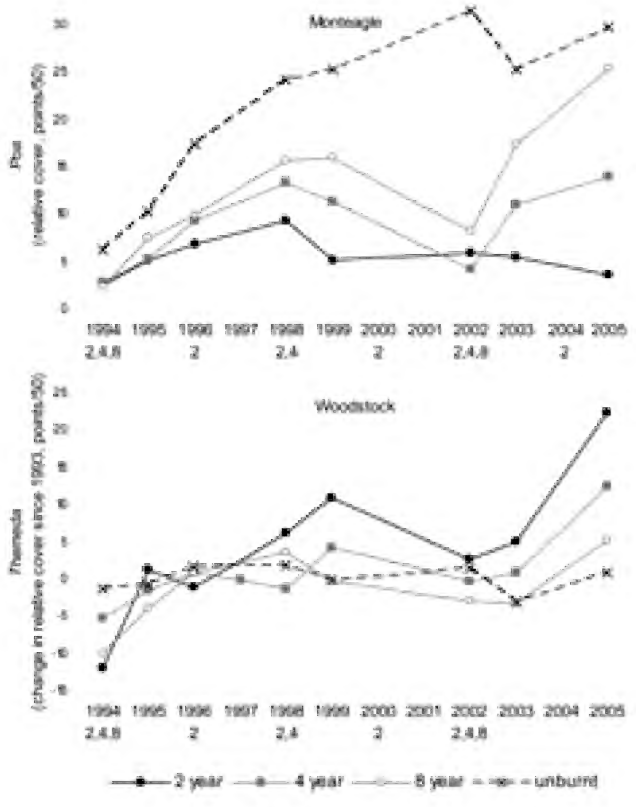

Figure 2. Effects of fire frequency on the relative cover of Poa *at Monteagle (top graph) and* Themeda *at Woodstock (lower graph), since 1994. The top graph shows how* Poa *increased dramatically when burning was stopped (unburnt) or reduced (8 year interval) at Monteagle, a site initially dominated by* Themeda*. The second graph shows how re-introducing fire caused a steady increase in* Themeda *at Woodstock, which was initially dominated by* Poa*. The years that burns were carried out are indicated by 2 (for plots burnt at 2 year intervals), 4 (4 year intervals) or 8 (8 year intervals). Note that decline in tussock cover in the burn years can be due to immediate effects of the burn rather than indicating long term trends.*

reduction in sward cover, with recovery by 2005, indicating that drought may have provided an alternative form of disturbance in unburnt plots. Informal observations at Monteagle indicate that the grassy sward may eventually degenerate in the absence of burning or mowing, but over time-frames greater than 10 years.

At Woodstock, re-introduction of burning led to a steady increase in *Themeda* with each burn (Fig. 2), and *Themeda* became dominant on 2 year plots. *Poa* on the other hand, recovered slowly after burning.

At both sites, effects of fire frequency on subsidiary native species were relatively minor. We are still analysing these results, so will describe them further at a later date.

Effects of fire on resilience to burning

At Woodstock, changes to the relative dominance of *Poa* and *Themeda* caused by fire influenced the resilience of the grassy sward to subsequent fires. All plots except for unburnt controls were burnt in 2002, and so in the following years we could compare their rates of recovery. Plots that had been burnt most frequently (every 2 years) over the previous 10 years recovered more rapidly than plots burnt less frequently (at 4 and 8 year intervals, Fig. 3). We believe this is because frequent burning had changed the grassy sward at Woodstock from one dominated by *Poa* to one dominated by *Themeda.* As our results showed, *Themeda* is more fire resilient than *Poa,* and thus *Themeda* dominated swards on 2 year plots recovered well after the 2002 burn, while *Poa* dominated swards on 8 year plots recovered poorly.

Results at Monteagle were almost the opposite of those at Woodstock, with plots burnt at an 8 year intervals recovering more rapidly from the 2002 burn than plots burnt every 2 years (Fig. 3). This at first seems confusing,

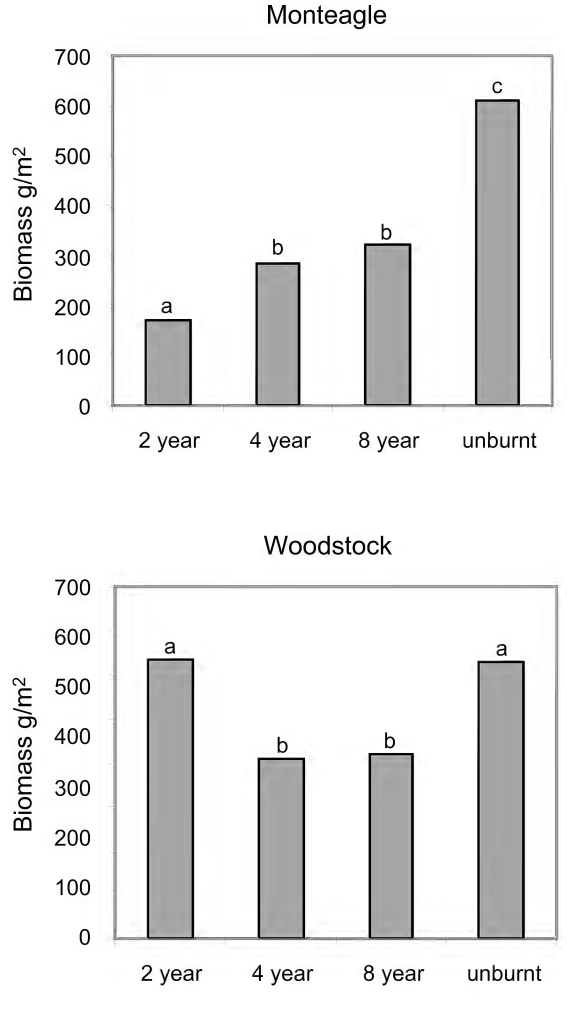

Figure 3. These graphs show sward biomass in January 2004. All except unburnt control plots were burnt in 2002, so for burnt plots biomass represents their recovery since 2002. At Monteagle, the plots burnt at 2 year intervals were slowest to recover because the Themeda *tussocks had become depleted by repeated burning. At Woodstock (the historically unburnt site), the plots burnt at 2 year intervals were fastest to recover because they had become dominated by* Themeda*, compared with other plots which were still dominated by the more fire-sensitive* Poa*. Different letters indicate significant differences (P<0.05).*

but again makes sense when we consider the initial composition of the grassy sward. The grassy sward at Monteagle initially had a high *Themeda* component, presumably due to the long-term history of frequent burning at the site. Although plots burnt every 8 years had built up a higher component of *Poa* by 2002, they still retained a high cover of *Themeda,* and thus recovered well from the burn. Plots burnt at 2 year intervals were less resilient to the 2002 burn than plots burnt at 8 year intervals, and we even observed significant death of *Themeda* tussocks, indicating that tussocks had become depleted under very frequent burning at this site. This is in strong contrast with recommendations for annual to biennial burning to maintain plant diversity and productivity in other temperate Australian *Themeda* grasslands with similar annual rainfall (Morgan and Lunt 1999; Lunt and Morgan 2002), although *Themeda* mortality in our study is likely to have been exacerbated by drought conditions.

Management implications

The results of our long-term studies have a number of important implications for management of *Themeda-Poa* ecosystems.

1. Broadly, burning frequencies needed to maintain grassy woodlands of the NSW western slopes are lower than those in the productive *Themeda* grasslands of the basalt plains in Victoria (Lunt and Morgan 1999).
2. Response to burning is highly dependent on the initial species composition of the grassy sward. *Themeda* dominated swards have greater ability to recover and higher disturbance needs than *Poa* dominated swards.
3. Our results support the '*status quo*' view, that past management should continue if the current ecosystem state is to be maintained. Significant changes to historical disturbance regimes are likely to result in substantial changes in the abundances of dominant grasses.
4. The presence of more than one dominant grass in the sward provides opportunities for adaptation to different disturbance regimes. Where the grassy sward comprises a mix of *Themeda* and *Poa,* it is likely to be moderately robust to variable burning frequencies, and an important goal should be to maintain an effective balance of these dominants through manipulation of disturbance frequency.
5. Where the initial abundance of one of these species is too low, the ecosystem may be less robust to changes in management. A shift to a more mixed sward may be possible if seeds are present, but the ecosystem is likely to pass through a vulnerable phase during this process. Management decisions may thus be better informed by historical management (*status quo*) and by monitoring the vigour of the current dominant.
6. The importance of *Poa* in mesic temperate grassy woodlands is often overlooked. This study has highlighted the significant role *Poa* plays, as a prominent species potentially compensating for *Themeda* decline when swards remain undisturbed for long periods.
7. In all cases, disturbance needs are likely to decrease during drought, and other factors such as fauna habitat, weed invasion and subsidiary plant diversity will also require consideration. We will report on some of these in the near future.

In conclusion, we suggest that rigid prescription of disturbance regimes for the conservation of these ecological communities is inappropriate. Rather, the species composition and vigour of the grassy sward, and an understanding of recent disturbance regimes (*status quo*), provides a valuable guide to disturbance needs. It is important to recognise that maintaining the *status quo* is not synonymous with 'doing nothing'. Ongoing monitoring of the vigour and abundance of dominant and subsidiary species is critical for the conservation of these endangered ecosystems.

Acknowledgements

This study was supported by the Grassy Box Woodlands Conservation Management Network (Natural Heritage Trust), a Competitive Grant from Charles Sturt University, and the New South Wales Government through its Environmental Trust. The Monteagle and Woodstock Bush Fire Brigades skillfully conducted regular burns, and particular thanks go to Keith and Gail Butt (Fairfields) and Hugh Jackson (Young Shire Council) for ongoing assistance.

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Grassland restoration in the south east of South Australia

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Native grasslands are a scarce resource in the south east of South Australia. Only 25% of the original area remains, reduced to small isolated pockets amongst expanses of farming, forestry and irrigation. Native grasslands are considered to be a rare vegetation community within this region (Croft *et al.* 1999). Historic threats to grasslands included over-grazing, weeds (such as *Phalaris*), reduction in fire regime and fertilising.

Since the late 1990's two local conservation management agencies, ForestrySA and the SA Department for Environment and Heritage (DEH), have been restoring two grassland sites 7 km apart in the lower south east district, at Piccaninnie Ponds and Dry Creek. Both sites are characterised by shallow soils over limestone with remnant tussocks of *Poa*, *Themeda*, *Austrostipa* and *Austrodanthonia*, along with a myriad of herbs in the inter-tussock spaces. Piccaninnie Ponds is a coastal system grading into a wetland complex on peat soil, and is managed by DEH. The Dry Creek Native Forest Reserve (NFR) is associated with a dry creek bed and flood plain linked to the Glenelg River (in Victoria), and is managed by ForestrySA.

Figure 1. Grassland Copper Butterfly. Larvae feed on Oxalis perennans*, a common plant species at Dry Creek Native Forest Reserve. Photo: Bryan Haywood*

As outlined in Croft *et al.* (1999) the two sites are within the Hatherleigh, Millicent and Mt Gambier threatened habitat district which is characterised as an 'area extensively cleared with only a few isolated remnants remaining'. Foulkes and Heard (2003) highlighted the significance of native grasslands in the region and strongly suggested the need for further field work to locate and survey grasslands across the region.

The two sites are habitat for a range of local threatened flora and fauna including orchids, herbs, reptiles, butterflies and birds. Species present include the Grassland Copper Butterfly (*Lucia limbaria*) (Fig. 1) and Orange-bellied (*Neophema chrysogaster*) and Blue-winged (*Neophema chrysostoma*) Parrots. In addition, the potential for legless lizards (Pygopodidae) reinforces that these sites are worth preserving. The site at Piccaninnie Ponds also remains potential habitat for the nationally endangered Maroon Leek-orchid (*Prasophyllum frenchii*), which occurs in similar habitat in the adjacent Conservation Park. Furthermore, this site provides food for the Orange-bellied Parrot in one of the few areas of South Australia that the species is still known to frequent.

The following is an account of current and future works for both sites.

Piccaninnie Ponds (DEH)

- purchased from neighbour in 2004 with National Reserve System funding;
- constructed new fencing and de-stock site (2005);
- undertook flora surveys and set up long term vegetation transects and pre- and post-burn fire monitoring plots in 2005;
- burnt west compartment (7 ha) in summer 2005 and 2006, and proposed to burn east compartment in summer 2006 and 2007 to assist in rejuvenating native perennial plants, and to assist in control of annual grasses and weeds;
- conduct future fauna surveys, and
- site is proposed addition to Conservation Park.

The prescribed burn in 2005 (Fig. 2) appears to have reduced the number of weedy annual grasses, with native grasses recovering well. Observations have recorded some new native species at the site, such as Running Postman (*Kennedia prostrata*), Old Mans Beard (*Clematis microphylla*), Sundew (*Drosera* sp), Flax-lily (*Dianella* sp) and Australian Bindweed (*Convolvulus erubescens*).

Figure 2. Piccaninnie Ponds, prescribed burn, 9 March 2006. Photo: Steve Clarke

Dry Creek NFR (ForestrySA)

- removed sheep from site in 1998. Site remained grazed by kangaroos and wombats only (Fig. 3);
- observation of Grassland Copper Butterfly colony throughout site in February 2006;
- development of rehabilitation plan in consultation with local botanical experts, including DEH;
- set up and surveyed 1 m x 1 m x 1 m pasture cages to assist in initial plant identification throughout site and impacts of grazing pressure (Spring 2006);
- set up long term enclosures to monitor grassland restoration (2007);
- undertake annual fauna surveys throughout site for reptiles and butterflies (2007), and
- burn small area in summer/autumn season and monitor results (2007/08).

Further reading

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Figure 3. Dry Creek NFR dry creek bed valley, showing extent of native tussocks in February 2006. Photo: Bryan Haywood

The Victorian Northern Plains Conservation Management Network

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Grassland conservation

Natural lowland grasslands of south-eastern Australia have been reduced and fragmented to such an extent that they are considered one of the most endangered ecosystems in Australia. It has been estimated that as little as 0.5% of natural grasslands and grassy woodlands remain in Victoria. As a result of this depletion, grasslands now contain an excessively high number of threatened species. In Victoria, Northern Plains Grasslands are listed under the *Flora and Fauna Guarantee Act 1988* (FFG Act). To combat this decline in biodiversity, a Conservation Management Network (CMN) has been established with funding from the Australian Government's Natural Heritage Trust.

Victorian Northern Plains Grasslands

When Europeans first arrived, grasslands of the Northern Plains are estimated to have covered about 345,000 hectares. Since this time, a combination of land uses has dramatically reduced the cover and forged a highly fragmented landscape. Today, grasslands can be found as isolated patches along railway lines, roadsides, crown land and freehold land, with the majority found on freehold land. An impressive diversity of plant and animal species live within the grasslands of the Northern Plains, many of which are threatened statewide or nationally. Of note are plants such as Turnip Copperburr (*Sclerolaena napiformis*), Chariot Wheels (*Maireana cheelii*), Red Swainson-pea (*Swainsona plagiotropis*), Spiny Rice-flower (*Pimelea spinescens* subsp. *spinescens*) and an un-named Leek-orchid (*Prasophyllum* aff. *occidentale D*). Animals of note include the Striped Legless Lizard (*Delmar impar*), Plains-wanderer (*Pedionomus torquatus*) and Golden Sun-moth (*Synemon* sp aff. *selene*).

The role of Conservation Management Networks

Conservation Management Network groups have been established in NSW and Victoria to provide links between land managers of remnant vegetation in similar vegetation types and to encourage increased protection. Linking land managers lets them share knowledge, coordinate their works and put funding to best use.

Northern Plains Grassland Conservation Management Network field trip, Echuca Rail Reserve. Photo: Darren Bain

Victorian Northern Plains Grasslands, Terrick Terrick National Park. Photo: Cathy Willis

The Victorian project has established a network of grassy sites in the Riverina area and is called the Northern Plains Conservation Management Network (CMN). The Network includes sites over the Northern Plains that contain grasslands and grassy woodlands. Many landholders are already managing their grasslands in a sustainable way, and have been for many years. With the establishment of the CMN we can now offer incentives, advice, detailed flora species lists and management plans to help protect these threatened ecosystems into the future. The CMN has a local working group that provides direction for the Network. All CMN members are to assist in decision-making, help promote Network activities to the general community and contribute to an improvement in the local environment.

Objectives of the CMN are to:

- promote the development and understanding of the Conservation Management Network concept;
- improve landholders' awareness and understanding of the biodiversity values of grassy woodland/ grassland ecosystems;
- contribute to the long-term sustainability of grassy woodland/grassland ecosystems by offering management advice and incentives, such as fencing grants;
- identify priority areas (including critical, common and potential) for the CMN, and
- ensure that improved vegetation management and biodiversity conservation activities are an essential part of sustainable farming practices.

Target areas

The target area for the Victorian Northern Plains Grassland Conservation Management Network encompasses Mitiamo, Pyramid Hill, Echuca and Gunbower. These boundaries are flexible and can be adjusted to include additional areas when required.

'Plains Talk'

A quarterly newsletter called 'Plains Talk' is published by the Victorian Northern Plains CMN and accepts articles from landholders that have a story they would like to tell. The landholders on the mailing list are already finding it a great networking opportunity to join up with other landholders in their area with similar issues, or to hear about landholders further afield and how they are managing their grasslands. If you would like to receive more information, contribute an article for the newsletter or be put on the mailing list please contact Darren Bain on (03) 5430 4801.

Conserving Natural Temperate Grasslands in the Southern Tablelands

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'Australia Felix', the term used by the explorer Mitchell as he traversed the grasslands and woodlands of south-eastern Australia in the 1830s (Environment ACT 2005) reflected the apparent boundless agricultural potential of the area. That potential has been well realised over the past 170 years, much of it at the expense of native grasslands. Estimates vary, but at the time of European settlement there were probably more than 480 000 hectares of grassland on the Southern Tablelands of NSW and the ACT. Today only around 3% of that area supports native grasslands that retain a level of ecological integrity. As a precaution against further loss, and to begin the process of recovery, Natural Temperate Grasslands (NTG) of the Southern Tablelands (NSW & ACT) was listed in 2000 as an Endangered Ecological Community under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999*.

To assist in the task of describing, locating and conserving this ecosystem, the National Recovery Team for Natural Temperate Grasslands of the Southern Tablelands was formed. The Recovery Team is comprised of representatives from a mix of government agencies and community groups, all of whom share an interest in managing native grasslands. Farmers, conservation groups and land management agencies all provide input into how the Recovery Team collects and uses information about NTG. Together with the Commonwealth Department of Environment and Heritage, the Recovery Team has been directing a program to implement the National Recovery Plan for NTG.

Today we are two years into the implementation program and are starting to make important progress on the work of describing and understanding NTG.

What is NTG?

Defining an ecological community is always a task fraught with difficulty and the process is not aided by the naturally dynamic and diverse nature of grasslands. Consensus was reached that NTG comprised the following combination of key defining characteristics:

- occurrence within the Southern Tablelands at altitudes up to 1200 m;
- not more than 10% projected foliage cover of trees, shrubs or sedges;
- dominated by native grasses and/or native forbs, and
- possessing a diversity of native forbs (including existing plants and the soil seed bank).

Armed with a definition, field staff have undertaken a series of botanical surveys over the last two years to locate remnants of NTG and collect information on their condition.

An example of Natural Temperate Grassland near Taralga. Photo: Greg Baines

Assessing the current distribution of NTG

Locating NTG is a bit like finding the proverbial needle in a haystack. The difficulty arises not only because NTG is rare, but also because it primarily occurs on private land and it can't be easily identified from traditional sources such as aerial photography. To address this last issue the NSW Department of Environment and Conservation (DEC) commissioned a series of groundcover vegetation models based on satellite imagery.

Modelling used multi-temporal imagery to differentiate between native and introduced grasses. Native grasses tend to continue their growth over summer whereas introduced grasses tend to grow in the cooler months and may remain active throughout winter. The resulting seasonal differences in greenness provide a basis for the models, but the critical steps in modelling revolve around aspects such as masking of non-grass areas, seasonal distribution of bare ground and incorporation of digital elevation data to compensate for limitations in imagery. The image analysis was informed by pre-existing floristic data collected by NSW DEC and the results were tested against post analysis field checking.

The result was a series of models that have allowed the survey teams to locate possible NTG in previously unsurveyed locations as well as allowing for an updated estimate of remaining NTG within selected parts of the Southern Tablelands.

Grass identification field day with Windellama Landcare Group. Photo: NSW Department of Primary Industries

Field surveys

Over the past three years field surveys have been undertaken on 40 private properties and over 60 public sites within the northern third of the Southern Tablelands to collect information on the floristic composition of NTG. This information has been added to data collected by NSW DEC, the ACT Government and Royal Botanic Gardens Sydney. The data are currently being analysed to determine the floristic associations and component species of the community across its range.

The ACT Government and NSW DEC have cooperated in the analysis process by developing corresponding grassland databases so that information can be consistently collected and shared between the two jurisdictions.

On the ground

With less than 1000 ha of NTG protected within reserves, private landowners hold the key to NTG conservation. Over the next 12 months there will be increasing focus on increasing landowner's knowledge and skills in grassland management. In addition to landowners directly involved in the survey process, in the last three months, over 100 people have attended grassland information sessions and grass identification workshops. General management guides have been provided to all participating landowners and Sarah Sharp presented the Grassy Ecosystem Management Kit to the ANPC's 'From the Ground Up' workshop in Canberra in November 2006. The kit provides detailed information on the management of sites with a grassy understorey, includes sections on how to collect relevant field information and set management aims and highlights potential management activities and reference material.

The Catchment Management Authorities (CMAs) in the Southern Tablelands are rolling out a number of incentive schemes relevant to the conservation of native grasslands. The survey process has allowed us to build links between landholders with NTG remnants and the CMAs. Hawkesbury-Nepean CMA has been very proactive in the area of NTG conservation and they have cooperated with the NTG Recovery Team members in arranging field days as well as developing incentive projects to assist NTG conservation at two key sites. In one instance they are assisting the landowner in controlling weeds and improving stock management in his grasslands, whilst at the other site they are assisting in major salinity and erosion control.

The Recovery Team is only one of many groups working on the conservation of grasslands. Cooperation between all groups, from individual landowners to government departments, is the key if we are to protect one of the country's most depleted ecological communities.

If you would like further information on the activities of the NTG Recovery Team or NTG conservation please call Greg on (02) 6207 2116.

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Conservation of Monaro Golden Daisy habitat

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Background

Old Cooma Common Grassland Reserve is a 45 ha natural temperate grassland on a steep hilly rise overlooking Cooma and is dominated by large plants of Poa Tussock (*Poa sieberiana*) and Kangaroo Grass (*Themeda triandra*). It is an excellent example of what the natural temperate grasslands of Monaro probably looked like. Cooma-Monaro Shire Council has been the Crown land trustee of the reserve since 1964 when the commonage was revoked. Friends of Grasslands (FOG) first visited Old Cooma Common (at that time called 'Radio Hill') in October 1998.

FOG undertook its first plant survey of the site soon after. Amongst the many native plants recorded were Monaro Golden Daisy (*Rutidosis leiolepis*), a threatened species, as well as the nationally threatened Hoary Sunray (*Leucochrysum albicans* var. *tricolor*) and Australian Anchor Plant (*Discaria pubescens*), a rare grassland plant. FOG also observed large numbers of woody weeds, especially small trees of Hawthorn and Briar Rose, patches of African Lovegrass and some Serrated Tussock, and large amounts of St John's Wort and Vipers Bugloss.

Funding of $18,338 was received in 1999 under the Threatened Species Network (TSN) Community Grants Program for the project *Conservation of Monaro Golden Daisy habitat*. The project planned to establish grassland reserves at Radio Hill (Cooma) and the Adaminaby Golf Course. The Adaminaby community subsequently withdrew its support for the project and the project became focused on Old Cooma Common.

Aims of the project

The project was a partnership between the Cooma-Monaro Shire Council, FOG and the World Wide Fund for Nature (WWF) Monaro grassland project. The Shire Council has also actively supported the project with funding and resources.

The WWF Monaro grassland project focused on natural temperate grasslands in the Monaro region of NSW. This was one of several WWF grassland projects in south east Australia. These involved grassland identification on public and private land, making recommendations for conservation management (usually only a subtle change to existing management), and targeted public education. The Monaro grassland project has since become the Monaro Grassland Conservation Management Network (CMN) supported by the Southern Rivers Catchment Management Authority (SRCMA) with funding from the NSW and Commonwealth Governments. Old Cooma Common became a founding and flagship area for the Monaro Grassland CMN.

Friends of Grasslands was keen to establish a stronger presence outside the ACT. It viewed this project as ambitious and somewhat daunting, given that Cooma is a seventy-five minute drive from Canberra. However, the project offered the opportunity for FOG to develop its on-ground skills, and FOG was keen to support the project and the Monaro Grassland CMN. FOG also realised that it could only provide limited resources and would be heavily reliant on the Project Officer for his continuing involvement.

The aims of the project were to:

- protect the grassland vegetation communities and associated threatened species on public land;
- establish greater knowledge of Monaro Golden Daisy;
- provide education resources for local people and tourists, and
- facilitate further scientific research into native grassland species and ecology.

Achievements and reflections

The project removed internal reserve fences, established a perimeter fence and targeted woody and herbaceous weeds, including introduced grasses. The project funds covered herbicide and fencing costs and work was undertaken by a mix of Council employees, hired contractors and FOG working bees. WWF provided additional funds for surveying the legal boundary and repairs to the existing partial boundary fencing and herbicide. The project's funds also contributed to Andrew Young's (CSIRO) work on the

Monaro Golden Daisy. Photo: Geoff Robertson

genetics of the Monaro Golden Daisy, which has increased our understanding of this species.

The first working bee took place in January 2000, followed by monthly working bees throughout 2000, which were reported in the FOG newsletter. By August 2000 some 26 FOG members had attended working bees. Participation continues today and some FOG members have become regulars. Special mention should be made of Margaret Ning who has been the key organiser and weed expert for these working bees.

Over fifty people attended the official opening of the Old Cooma Common Grassland Reserve in September 2001 and the event received local press coverage. A promotional and interpretive flier, also funded by the project, was released.

With this firm base, FOG activities around Cooma have blossomed, and for example it attracted 100 people to its *Grassland beyond the reserve* workshop and grassland tour in December 2001, attracting an audience from across NSW. In November 2003, the Stipa Native Grasses Association and FOG's third native grasses conferences was held in Cooma.

Recent developments

In recent months, Cooma-Monaro Shire Council has drawn up a draft weeds management plan for Old Cooma Common Grassland Reserve. Council and FOG have agreed in principle to establish a joint reserve management group,

Monaro Golden Daisy in flower at Old Cooma Common Grassland Reserve. Photo: David Eddy

Friends of Grasslands working bee, Old Cooma Common Grassland Reserve, March 2006. Photo: Geoff Robertson

with Council, FOG and local community representation. This group will investigate strategic livestock grazing for weed and conservation management on the reserve. The costs associated with the weeds management plan will be borne by Council and the grazier concerned.

Conservation grazing is a tool used to manage biomass and weeds in grassland reserves and is not without its critics, especially as grazing can create problems of its own. For success, careful management is required, including creation of smaller paddocks so that grazing is controlled to ensure that selective grazing is minimised, and thoughtful design and placement of watering points. Monitoring, if carefully devised, can measure impacts on plant growth and vegetation structure, the presence/absence and/or abundance of particular species, and impacts on soil. FOG is giving some attention to a good monitoring regime.

Concluding remarks

The biggest winner has been the Monaro Golden Daisy and Monaro grasslands. Since the inception of the project we have found several more populations of the Daisy, whose future now seems more secure. Monaro grasslands, a threatened ecological community, are now regarded as an important part of the regional landscape and heritage.

At the reserve's opening, some locals summed it up. 'Deep down' one person said 'we always thought that our landscapes were special, but we were told that they were unnatural and the result of clearing. We felt like second-class citizens. This project turned that around and made us proud of our grasslands.' Students from Monaro High School also pointed out that Old Cooma Common Grassland Reserve had become a centre for their nature study.

Further information

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Response of the endangered grassland plant *Acanthocladium dockeri* to fire

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Acanthocladium dockeri (Spiny Daisy) is a critically endangered shrub occurring in four remnant native grassland populations in the Mid-North of South Australia. All populations are restricted to roadsides and are surrounded by cleared, arable farming land. Each natural population consists of a single, distinct, genetic clone, proliferating vegetatively by root suckering (Jusaitis and Adams 2005a).

Although *A. dockeri* flowers prolifically, seed production is extremely low as a result of low pollen viability and germination (Jusaitis and Adams 2005b). Moreover, no naturally occurring seedlings have been observed at any population site, even though seed was found to germinate readily in laboratory trials (M. Jusaitis, unpubl. data).

The occurrence of a natural wildfire through one of the populations provided the opportunity to study regeneration of this plant in response to fire. The Rusty Cab population (Jusaitis and Adams 2005b) near Laura was burnt after lightening started a fire on a nearby knoll on 25 January 2001. The fire, fuelled by stubble in the neighbouring paddock, spread through the roadside population of *A. dockeri* and was eventually contained by the road.

After the fire, ten contiguous plots (each 1 m^2) arranged in a 5 x 2 m grid pattern were pegged out for regular monitoring of the population. On each visit to the site thereafter, *A. dockeri* ramets (individual members of a clone) in each plot were counted, and the % cover of their above-ground biomass was estimated visually. After plants began to regenerate, six were selected from across the monitoring site for regular growth measurements. Height (H), the maximum width (W1) and the width at right angles to this (W2) were measured to the nearest 5 mm, and a growth index was calculated as (H+W1+W2)/3.

Figure 1. A. dockeri *plants regenerating seven weeks after fire. Photo: Manfred Jusaitis*

Fire effectively destroyed the above-ground shoots of *A. dockeri* plants in the monitoring plots, leaving behind charred or desiccated stems. New shoots, emerging from below ground at the base of burnt plants, were observed seven weeks later (Fig. 1). Out-growth of above-ground axillary buds was occasionally seen also, but only on stems that had not been fatally singed. No regeneration from seed was noticed.

The density of regenerating *A. dockeri* plants increased almost linearly during the first year after fire, stabilising at about 10 plants per m^2 by the end of the second year (Fig. 2). Size and cover of plants increased exponentially over the first year, but both attributes plateaued early in the second year (Figs 2 & 3). An increase in cover during year

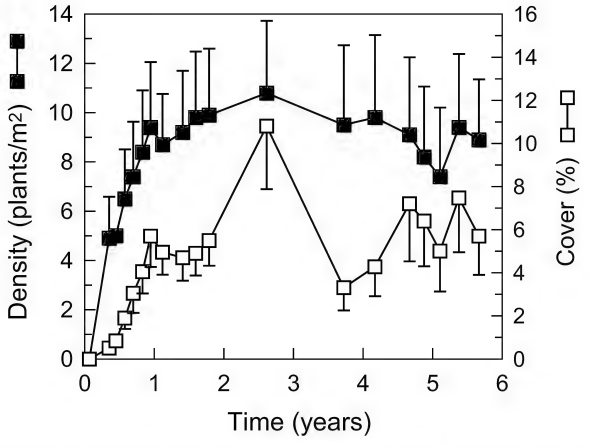

Figure 2. Density and percentage cover of A. dockeri *plants following wildfire on 25 January 2001. Time (0) corresponds with 1 January 2001. Vertical bars represent SE mean (n = 10).*

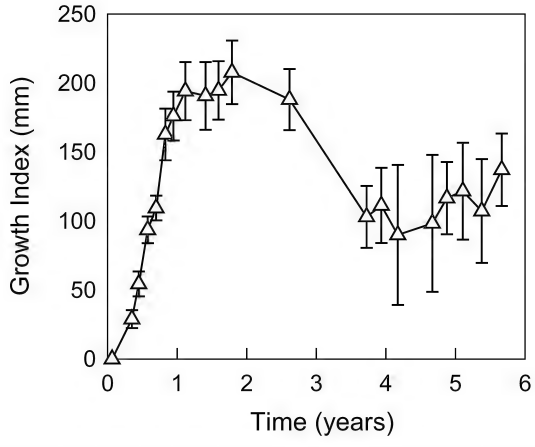

Figure 3. Growth of regenerating A. dockeri *plants following wildfire. Time (0) corresponds with 1 January 2001. Vertical bars represent SE mean (n = 6).*

three was attributable to an increase in the number of regenerating ramets rather than to an increase in growth (Figs 2 & 3).

A dramatic decline in growth index and percentage cover of *A. dockeri* three years after the fire coincided with a resurgence of the introduced Common White Snail (*Cernuella virgata*). This snail, frequent throughout the habitat of *A. dockeri*, has previously been observed grazing on *A. dockeri* plants (Jusaitis and Adams 2005b) and is capable of causing death of shoots and whole plants by ringbarking stems. While a few snails were seen at the Rusty Cab site as early as 10 months post-fire, their numbers increased markedly during the third year, coincident with the first observations of snail damage on *A. dockeri* plants (Fig. 4).

Figure 4. Damage to A. dockeri *shoots caused by the introduced Common White Snail (*Cernuella virgata*). Photo: Manfred Jusaitis*

Flower buds and flowers were seen on regenerating plants a year after the fire, although no seed resulted from that flowering. A year later (March 2003), 0.03 seeds per capitulum were recorded for this population, consistent with the low rates of seed production observed from the other known populations (Jusaitis and Adams 2005b).

In summary, it appears that *A. dockeri* is capable of rapid regeneration after fire. However, only vegetative regeneration was observed, involving regrowth of shoots from below-grown root-stocks or from occasional above-ground shoots that had survived the fire – no seedlings were seen. Fire destroyed the resident population of introduced snails, giving plants a temporary reprieve from grazing damage. However, the snail population burgeoned again by year three, resulting in severe plant damage in the third and fourth years post-fire. On the basis of these results, the use of burning as a snail control strategy in the management of *A. dockeri* populations bears further investigation.

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Local adaptation and outbreeding depression: are we being overly conservative?

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Introduction

The primary objective in the conservation and management of threatened plant species is the maintenance or enhancement of long-term population viability. Many plant species in the grasslands of south-eastern Australia have experienced widespread declines in the number and size of populations due to habitat loss and fragmentation. Small or declining plant populations may suffer from genetic issues that can influence the long-term viability of these populations, including **inbreeding depression** and the loss of genetic diversity at the **self-incompatibility** (SI) locus (see glossary for terms in bold).

For small or declining populations, a means of improving population viability is to undertake **genetic rescue** by supplementing the population with individuals or seed from larger populations. Introducing new genetic material can be an important means of counteracting the negative effects of inbreeding depression. In addition, for species with self-incompatibility systems, the introduction of individuals with novel incompatibility alleles (*S*-alleles) can improve reproductive success within a population by increasing **mate availability**.

The movement of genetic material between populations does raise the issues of **outbreeding depression** and

disrupting patterns of **local adaptation**. There are a number of factors that can increase the risk of outbreeding depression, including the mating system as well as genetic and environmental differences between populations. Theory suggests that self-compatible species have a higher risk of outbreeding depression compared to self-incompatible species and that the greater the genetic and environmental differences between populations, the greater the risk of outbreeding depression.

A case study from the grasslands: *Rutidosis leptorrhynchoides*

An example from the grasslands of south-eastern Australia is the self-incompatible perennial daisy *Rutidosis leptorrhynchoides* (Asteraceae). This species has experienced widespread declines in population size and number due to habitat loss and fragmentation. Small populations have lower and more variable seed set, which is in line with the predicted demographic responses associated with reduced genetic diversity at the self-incompatibility locus. Small populations also have reduced *S*-allele diversity reflecting decreases in mate availability, which is particularly relevant for populations with <200 individuals (Young *et al.* 2000). Considering that many remnant populations are around this threshold, supplementing small populations of *R. leptorrhynchoides* with new genetic material to increase *S*-allele diversity would be an important potential management strategy to improve their long-term viability. Current experimental work has found that for small populations, crossing with plants from other populations has significant benefits for fertilisation success and in some cases can improve fertilisation success by up to 25%. This suggests that genetic rescue by introducing new *S*-alleles from crossing between populations has significant benefits for small populations.

Experimental studies have also been undertaken to examine if there are trade-offs in introducing new genetic material through the potential negative effects associated with the disruption of local adaptation and outbreeding depression. To examine local adaptation a transplant experiment was undertaken for 18 population pairs. This experiment used a range of fitness measures and found that local adaptation was not evident in all populations. To examine outbreeding depression, controlled crosses were undertaken between plants in 12 population pairs for three generations. No consistent evidence for outbreeding depression was observed across a range of fitness measures and instead **heterosis** (increased fitness) was observed in the majority of population pairs. This suggests that for *R. leptorrhynchoides,* the benefits of introducing new genetic material outweigh the risks of outbreeding depression and are more likely to positively influence long-term population viability.

Outbreeding depression: what does the literature have to say?

Although the case study of *R. leptorrhynchoides* is particularly relevant to the grasslands of south-eastern Australia, it is important to examine the scientific literature for additional information on the issue of outbreeding depression, even though relatively few studies have addressed these issues. A number of studies have found no evidence for outbreeding depression, but very few of these studies have looked beyond the first generation. Situations where outbreeding depression has been observed include crosses undertaken:

- over very large distance classes;
- between plant varieties (e.g. Montalvo and Ellstrand 2001), and
- in self-compatible species with a history of inbreeding.

In addition, some studies have observed outbreeding depression:

- to vary significantly year-to-year, suggesting that environmental variation has an important influence on its expression, or
- to occur only in the third generation, with positive fitness effects in the first and second generations and recovery of fitness in the sixth generation (Erickson 2006, Fenster and Galloway 2000).

Although there are good reasons why careful consideration is needed before mixing genetic material between populations, the potential risks need to be considered in the context of the benefits to small populations, particularly those with reduced *S*-allele diversity or where populations are suffering from inbreeding depression.

Glossary

GENETIC RESCUE: An increase in population fitness due to the introduction of new genetic material.

HETEROSIS: Increased fitness of offspring from matings between genetically unrelated individuals.

INBREEDING DEPRESSION: A reduction in the fitness of offspring from matings between related individuals.

LOCAL ADAPTATION: An increase in fitness of a local population due to an increase in the frequency of alleles favoured by the local environment.

MATE AVAILABILITY: The proportion of plants in the population that can potentially mate.

OUTBREEDING DEPRESSION: A reduction in the fitness of offspring from matings between genetically unrelated individuals.

SELF-INCOMPATIBILITY: The inability of a fertile hermaphrodite to produce seed after self-pollination. Successful mating can only occur between individuals that are genetically different at the self-incompatibility locus, i.e. that do not share self-incompatibility alleles (*S*-alleles).

Where to from here?

The challenge for on-the-ground management of threatened species is that decisions often have to be made in the absence of specific scientific data on the particular species of concern. Nonetheless, for many species with particular life-history traits, translocation of genetic material between populations may be an important and viable management option when source populations are carefully chosen. When considering supplementing small populations with new genetic material and examining potential source populations, a number of key questions should be addressed. These include:

1. is the mating system of the species known? Is it self-compatible or self-incompatible?
2. what are the environmental differences between the populations being considered?
3. is there anything known about genetic differences between populations?
4. are the plants from the populations morphologically different? and
5. are there chromosomal complexities in this species?

Maybe it is time to re-think the approach to managing small populations that has focused on keeping populations as geographically distinct entities. Obviously we need to approach these issues critically and thoughtfully, but for small populations where genetic issues such as reduced *S*-allele diversity and inbreeding depression influence demographic outcomes, careful choice of donor populations would ensure that the benefits outweigh the risks.

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Viability testing of Victorian Western Plains grasses

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The Grassy Groundcover Research Project (Greening Australia 2006) aims to address the decline in Plains Grassland and Grassy Woodland communities in south-eastern Australia. A primary element of the project is the use of direct seeding of multi-species seed mixtures to establish functional and persistent plant communities.

Wild-harvested grasses and forbs are sown as a mixture of seed and chaff. To determine sowing rates and to assess subsequent field establishment it is necessary to know the number of living (viable) seeds of each species in a known mass of the sown mixture.

This project compared the results of viability and germination tests for nine grasses indigenous to the Victorian Western Plains, and evaluated the usefulness of viability testing for the selected species.

A germination test under controlled conditions is commonly used to determine what percentage of a seed lot is ready to germinate immediately. However, if there are dormant seeds or if test conditions are sub-optimal, reported germination will be less than the percentage of viable seeds.

To assess viability, a physical or chemical test is used to establish the percentage of live seeds in a seed lot. The most common test for viability uses the fact that living tissue (such as the embryo in a seed) is stained red by a tetrazolium solution (TZ). The International Seed Testing Association (ISTA) publishes guidelines for TZ testing of cultivated species (Leist, 2003). The procedure is:

- imbibe a sample of the seed lot in water;
- cut the seeds to expose the embryo (if TZ can pass through tissues surrounding the embryo, cutting is unnecessary);
- soak the prepared seeds in TZ, and
- evaluate the staining pattern.

Imbibition and soaking times are species dependent, and the appropriate cutting technique will also vary among species. Grasses have an embryo that is relatively small and usually restricted to the lower half of the seed, with starchy endosperm, which does not stain in TZ, occupying most of the seed volume. The endosperm may be liquid.

The reproductive propagule of most grasses is technically described as a caryopsis, which is a dry, indehiscent, one-seeded fruit in which the seed coat is closely fused to the fruit wall. In addition, the 'seeds' of some grasses are surrounded by remains of the flowers (florets or spikelets). For simplicity, we use the term 'seed' below.

Method

For each species, four separate batches of seeds were:

- germinated under controlled conditions of light and temperature;
- physically examined under a dissecting microscope after 24 hours imbibition ('cut test');
- TZ tested without cutting, and
- TZ tested after being cut longitudinally to expose the embryo.

Seeds that were analysed were only those from filled florets. TZ testing was by soaking for 24 hours in 1% TZ at 30°C.

Results and discussion

The grasses varied considerably in their response to TZ (Table 1, Fig. 1).

Table 1. Estimate of viability and germination from seed lots of nine Australian grass species.

Species	Estimate of viability (%)			Germination (%)
	Physical examination	TZ uncut	TZ cut	
Austrodanthonia caespitosa	96	95	n/a	93
Austrostipa elegantissima	91	0	63	72
Bothriochloa macra	96	not tested	93	0
Chloris truncata	100	86	not tested	60
Dichanthium sericeum	92	82	85	93
Dichelachne crinita	73	0	82	43
Elymus scaber	99	95	not tested	100
Pentapogon quadrifidus	90	3	80	45
Themeda triandra	96	14	82	34

***Austrodanthonia caespitosa* (Common Wallaby Grass)** stains readily in TZ without needing to be cut.

***Austrostipa elegantissima* (Feather Spear Grass)** requires cutting and is slow to stain in TZ. This species has a small embryo and cylindrical seeds with an opaque tightly rolled outer layer (the lemma). Germination is slow in *Austrostipa* species (up to seven weeks for the sample studied) and viability testing is valuable in this situation.

***Bothriochloa macra* (Redleg Grass)** requires cutting before soaking in TZ. The sample tested was fully dormant (0% germination) but the estimated viability was 93%.

***Chloris truncata* (Windmill Grass)** stains readily without cutting, and filled seeds germinated rapidly. There was a very low rate of seed fill (8%).

***Dichanthium sericeum* (Silky Blue Grass)** stains readily without cutting.

***Dichelachne crinita* (Long-haired Plume Grass)** has liquid endosperm contained by a tough seed coat which needs to be pierced with a needle or probe before soaking in TZ.

***Elymus scaber* (Common Wheat Grass)** does not require cutting for TZ testing, but since it germinates quickly a germination test is easier.

***Pentapogon quadrifidus* (Five-awned Spear Grass)** has liquid endosperm like *D. crinita* and needs to be pierced before soaking in TZ.

***Themeda triandra* (Kangaroo Grass)** experiences dormancy of up to 12 months so TZ testing is useful in assessing a seed lot. Longitudinal cutting tended to bruise the embryo, so transverse cutting was used although staining is slower.

Summary and recommendations

Physical examination only gives a rough idea of viability and, at least for the species studied, is only useful for establishing seed fill and the extent of insect predation. A germination test establishes the percentage of seeds that are ready to germinate immediately, but does not distinguish between dormant and dead seeds.

The TZ test estimates the proportion of live seeds in a batch, and takes less time than a germination test. The seeds of many grasses require after-ripening before they will germinate. The viability test provides useful information about the quality of the seed lot in the interim. Preliminary recommendations for viability testing are provided (Table 2). For some species we have suggested a higher temperature for TZ testing because they were slow to stain at 30°C and every 5°C increase in temperature doubles the effective soaking time.

Suitability of TZ testing for inexperienced practitioners

TZ testing is a specialised skill but practical manuals are available (e.g. Leist 2003). The technique does require a certain amount of investment of time and money.

The following equipment is required:

- dissecting microscope and simple dissecting kit (forceps, probes, razor blades);
- 1% TZ solution and associated laboratory with Occupational Health & Safety procedures, and
- incubation and germination cabinets.

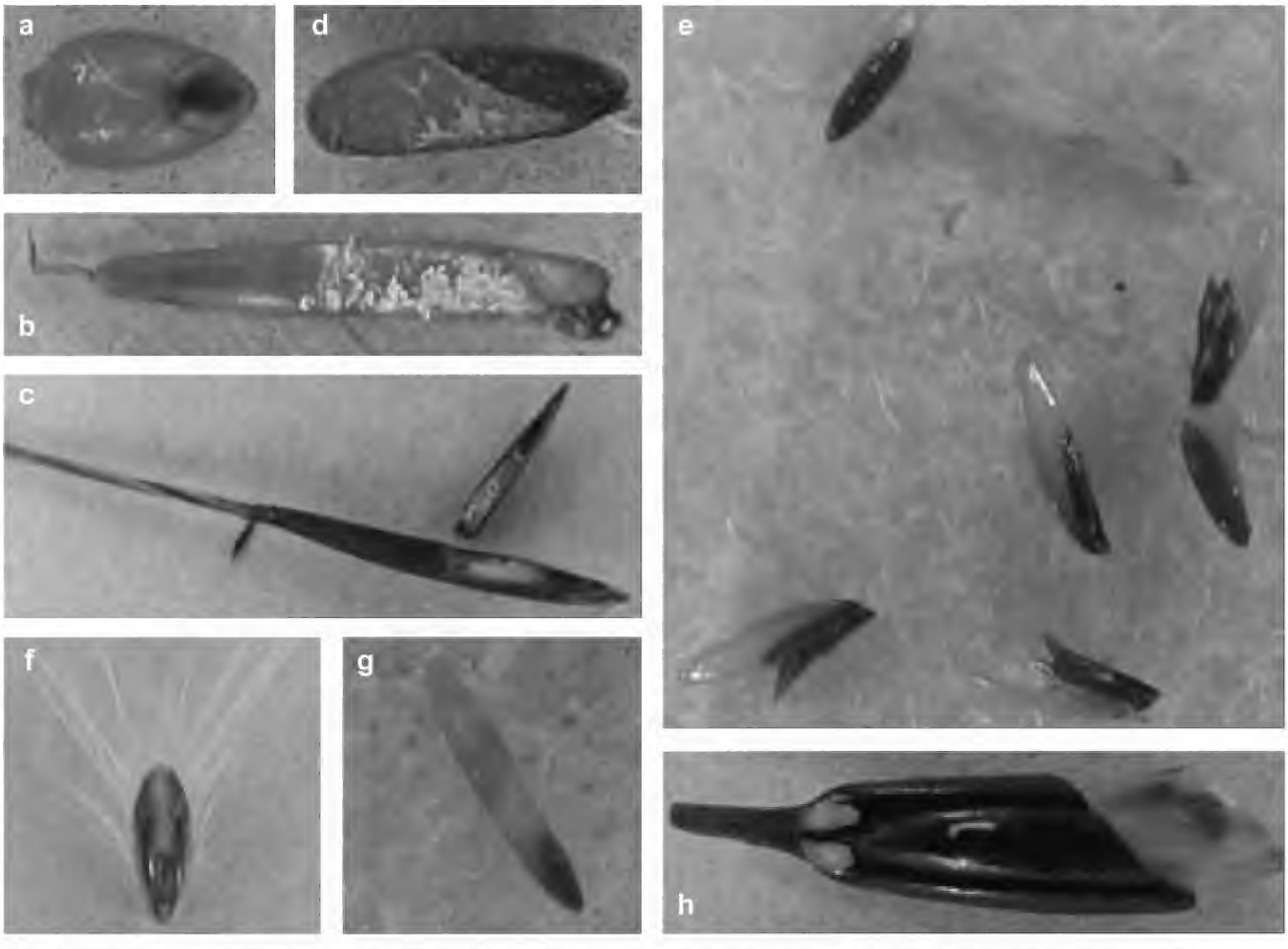

Figure 1. (a) Uncut Austrodanthonia caespitosa *seed (1 mm) with embryo stained by TZ. (b)* Austrostipa elegantissima *seed (2.5 mm) cut to expose the embryo. (c)* Austrostipa elegantissima *seed (4 mm) with stained embryo. (d) Cut* Bothriochloa macra *seed (1.5 mm) with stained embryo. (e)* Chloris truncata *seed (1 mm) after soaking in TZ. (f)* Dichanthium sericeum *seed (3 mm) with stained embryo visible through translucent outer covering (glumes). (g)* Dichelachne crinita *seed (1 mm) with stained embryo. (h) Partially stained* Themeda triandra *seed (2.5 mm) after transverse cutting. Photos: Marjorie Hall*

Table 2. Preliminary recommendations for viability testing for a range of Australian grass species.

Species	Recommended viability testing protocol
Austrodanthonia caespitosa	TZ test uncut seeds (24 h, 30°C); cut longitudinally for evaluation
Austrostipa elegantissima	Transverse cut seeds before soaking in TZ (try 24 h, 40°C)
Bothriochloa macra	TZ test longitudinally cut seeds (24 h, 30°C)
Chloris truncata	Germination test
Dichanthium sericeum	TZ test uncut seeds (24 h, 30°C); cut longitudinally for evaluation
Dichelachne crinita	Pierce seeds before soaking in TZ (24 h, 30°C)
Elymus scaber	Germination test
Pentapogon quadrifidus	Pierce seeds before soaking in TZ (try 16-18 h, 30°C)
Themeda triandra	Transverse cut seeds before soaking in TZ (try 16 h, 40°C)

Viability testing is exacting but nevertheless worthwhile if an estimate is needed quickly or dormancy may be present. Seeds are captivating, and anyone who has the time is likely to get a good deal of pleasure from the exercise as well as an increased understanding of a seed lot and its performance when sown.

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Storing tubers of Milkmaids (*Burchardia umbellata*)

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Introduction

Burchardia umbellata (Colchicaceae) is an attractive, spring flowering, native lily known by the common name Milkmaids. It is a tuberous, summer dormant perennial that is widely distributed in grasslands and herbaceous understoreys in temperate Australia (Walsh and Entwisle 1994). Although it is frequently included in species lists for revegetation, it is seldom available as tube stock because it can take two to three years to grow a plant that is large enough for field planting. A further challenge for nursery producers is that, although seed germinates readily under nursery conditions, each seedling dies back to a small tuber during summer. Little is known about the optimum management of these dormant tubers. If left in moist growing medium during the dormant phase, the surface of the growing medium can host undesirable mosses and liverworts, but if the medium is allowed to dry there is a risk that the tubers will desiccate. If the dormant tubers can be safely lifted and stored during dormancy for re-planting in autumn, a more manageable production system could be developed.

Clark (1994) reported that the related South African species *Sandersonia aurantiaca* can be stored in moist vermiculite (10% water by volume) at low temperatures (2.5 or 4°C) for up to 120 days. At 10°C, almost half of the tubers had either swollen or sprouted, especially for longer storage durations. In a later study, a storage temperature of 8.5°C was found to have no detrimental effect on the survival of tubers stored for up to 150 days (Clark and Burge 2002).

This study investigated the effect of substrate on the viability of young, nursery-grown tubers of *Burchardia umbellata*, in open storage at room temperature.

Materials and methods

Seed from numerous wild-harvested plants of *Burchardia umbellata* was sown into a pine bark based growing medium in autumn 2002. The seedlings were cultivated in a greenhouse where they underwent an annual cycle of growth during autumn, winter and spring, and summer dormancy. Thirty plants, as dormant tubers, were harvested in January 2006, washed, air dried and stored in open paper bags for 48 hours at 21°C. The tubers were weighed, dipped in fungicide (Sportak™ at 0.5 mL/600 mL) for 1 minute and air-dried for 2 hours. The 30 tubers were assigned to three weight groups (Table 1 and Fig. 1).

Table 1. The weight groups to which Burchardia umbellata *tubers were assigned (10 tubers per group).*

		Weight range (g)	Mean (g)
Group 1	Small	0.022 – 0.091	0.039
Group 2	Intermediate	0.107 – 0.220	0.145
Group 3	Large	0.250 – 1.160	0.645

Tubers from each of the weight groups were evenly distributed to one of the following three treatments:

1. ten tubers were each placed into individual 165 x 145 mm unsealed plastic bags, in moist vermiculite (10% water by volume);
2. ten tubers were each placed into individual 165 x 145 mm unsealed plastic bags, in air dry vermiculite, or
3. ten tubers were each placed into individual 140 x 175 mm open paper bags with no substrate.

All bags were randomised, packed loosely into a ventilated cardboard box and stored in the dark at 21°C for eight weeks. After removal from storage, tubers were rated according to whether roots or shoots were present, planted into pine-based potting medium in individual square forestry tubes and placed in an irrigated greenhouse.

In May 2006 plants were assessed as 'living' if a healthy shoot was present. Tubers that had not produced a shoot were recovered from the growing medium and assessed as 'intact' or 'rotted'.

Results

Significantly more tubers survived and re-grew after storage in moist vermiculite than from either of the dry storage treatments (Fig. 2). Nine of the ten tubers stored in moist vermiculite were viable after eight weeks of storage and five weeks of cultivation. Eight of these tubers had sprouted during the storage period. In contrast, three of the ten tubers stored in dry vermiculite were viable after eight weeks of storage and five weeks of cultivation. These three tubers also had sprouted during the storage period. Only one of the ten tubers stored in open paper bags with no substrate remained viable after storage and cultivation. This tuber had not produced a shoot during the storage period. All of the un-sprouted tubers that were recovered after five weeks of cultivation had rotted.

Of the thirteen tubers that survived storage and cultivation, five were from those classed as small (Group 1), four were of intermediate size (Group 2) and four were classed as large (Group 3).

Discussion

Burchardia umbellata is an abundant and persistent species in many high quality remnant understorey and grassland communities. However, because of its slow initial growth rate, small stature and annual summer dormancy, it is seldom grown for revegetation. This study investigated the practicality of lifting, storing and later replanting dormant tubers. Because of the limited number of tubers available, only one temperature was tested (21°C, representing room temperature).

Storage in moist vermiculite was very successful, with 90% of the tubers surviving. However, neither of the dry treatments can be recommended for storage at room temperature. Future research should focus on the efficacy of storage at cooler temperatures and at a range of moisture contents, both for improved tuber survival and the suppression of sprouting during storage (see Clark, 1995).

The benefits of refining storage treatments for *Burchardia umbellata* and other tuberous native species may include:

- improved nursery production systems that allow for the cost-effective production of tube stock for revegetation;
- the direct 'sowing' of small, dormant tubers onto revegetation sites (allowing for the establishment of larger and more competitive plants than from seed); possibly leading to
- the encapsulation of individual tubers for efficient longer-term storage and sowing (as is already happening with synthetic seed).

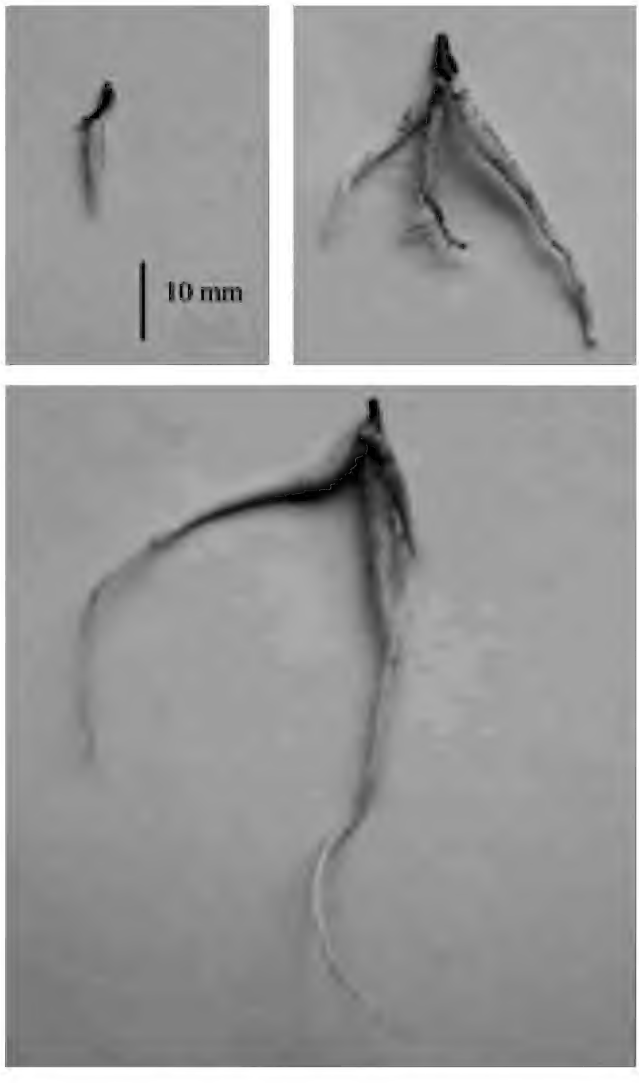

Figure 1. Burchardia umbellata *tubers representative of each of the three weight groupings.*
Top Left to Right: Group 1 (0.022 g), Group 2 (0.220 g).
Bottom: Group 3 (1.160 g). Photos: John Delpratt

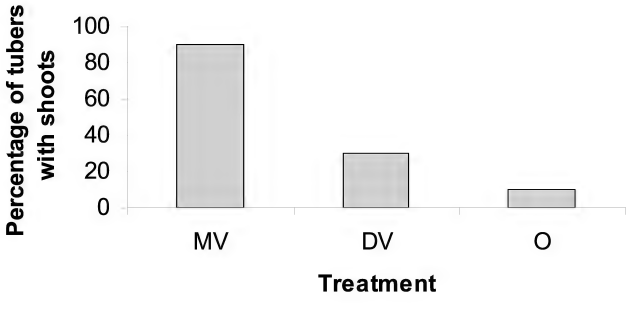

Figure 2. Percentage of living Burchardia umbellata *tubers after eight weeks of storage in three different storage treatments (MV = moist vermiculite, DV = dry vermiculite and O = open storage) followed by five weeks in greenhouse cultivation.*

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Friends of Grasslands – supporting grassy ecosystems

Kim Pullen and Geoff Robertson

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Introduction

To protect and ultimately recover grassy ecosystems, it is necessary to build strong community understanding, skills, and support. Friends of Grasslands (FOG) was launched to provide such support. FOG's first newsletter, 22 November 1994, shows that FOG's founders saw the need to attract attention to grassland conservation through community liaison, public education and information, development of posters, publication of an informative newsletter, and data collection and storage. Infrastructure and community building were also recognised as necessary, including more mundane issues such as incorporation, finances, sponsorships and grants.

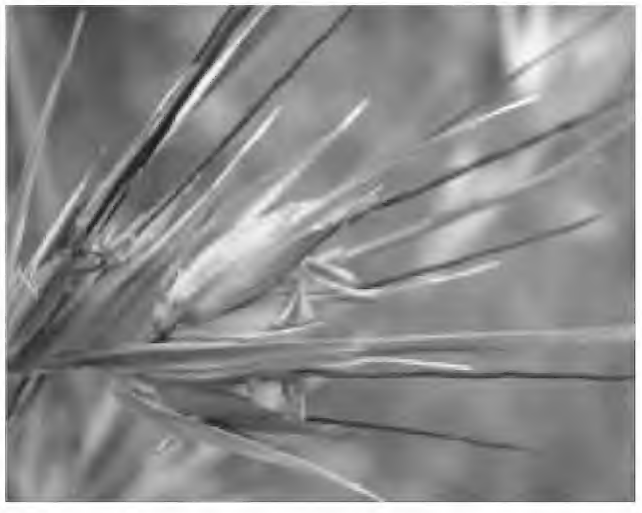
Getting off to a good start

To be successful, a new group must get off to a good start. The founding FOG members drew on many highly skilled people and were excited by a new concept of grassland conservation from the ecosystem perspective. The first FOG president, Edwina Barton, was described in an early FOG Newsletter as 'immensely enthusiastic and effective, with a wealth of experience, network of contacts, and total commitment to grassland conservation'. The eighty people who attended the launch of the organisation included many well known Canberrans who heard a number of talks on the state of grassland conservation. FOG, in its early days, experienced many great bursts of energy and retreat, and from late 1997, after a 'do we shut down or continue?' moment, a steady and prolonged flowering. However the FOG leadership continues to question whether FOG should continue in its current form, develop a different focus, or even bow out.

FOG's newsletter

Newsletters were initially infrequent, but in each year from 1999 six have been produced regularly. Seventy-two issues have now been published in total. FOG's newsletter advertises its program, records its story, and informs

Grassland merging into Snow Gum Woodland near Nimmitabel, NSW. Photo: Geoff Robertson



Left: FOG members investigating the grassland in Scabby Nature Reserve, Yaouk.
Right: Themeda triandra *in flower. Photos: Geoff Robertson*

and educates members on grassy ecosystem issues. It emphasises quality, good science, advocacy for grassy ecosystems, good news about grassland recovery, and respect for all viewpoints, and receives high praise from many quarters. A complimentary copy is always available for the asking.

Advocacy, education, on-ground work and research

FOG believes that recovering our grassy ecosystems requires advocacy, education, on-ground work and research, based on a good theoretical and practical grounding in grassy ecosystem conservation. FOG has made numerous submissions to governments and stakeholders, and its advice is actively sought. To underpin its approach, FOG has aimed to recruit practising scientists, land owners and managers, and committed conservationists to its ranks, and relied on them to provide their services on a voluntary basis. It has assisted a number of groups and organisations to meet their objectives, and from time to time has helped establish new like-minded groups. For its tenth birthday, FOG published an honour role of persons contributing to FOG. The list was long and contained the names of many impressive people.

FOG activities program

FOG provides a range of activities for its over 200 members, who are mostly from south-east Australia. It aims to cooperate with and compliment, rather than compete with, other groups. The program is varied in terms of geographical area visited and type of activity offered. FOG's philosophy is if only two or three people attend an activity but gain from it, it is a success and worthwhile doing. FOG has organised field trips in the ACT, in many regions of NSW and in all eastern states at one time or another. FOG has held three major workshops, and in 2003 cosponsored the Third Native Grasses Conference with Stipa Native Grasses Association. Nowadays we focus on more specialised and smaller workshops, catering for between 25 and 50 people, on specialist topics related to grassland ecology.

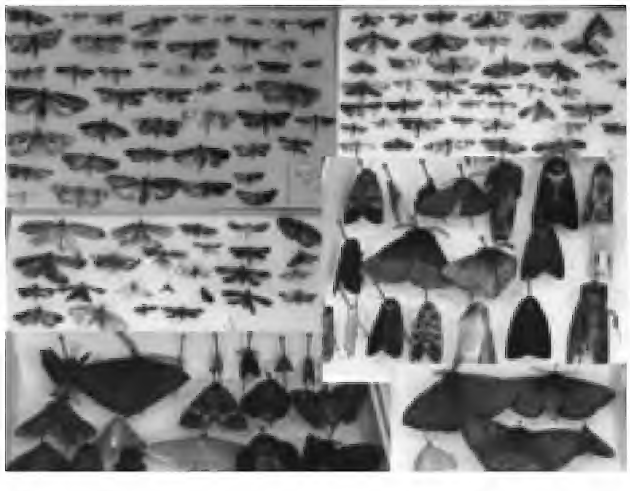
Concluding remarks

Friends of Grasslands was created to build community support for grassy ecosystem recovery. A focus on ecosystem conservation is now more common-place, and FOG has contributed to that. FOG's focus is on what is needed and how to make it happen – an example of *adaptive management*. An illustration of this approach is FOG's *Monaro Golden Daisy habitat* project, described on page 18 of this issue.

Further Information

Blowing our own trumpet, *News of Friends of Grasslands* Sept-Oct and Nov-Dec 2003.

Friends of Grasslands, supporting grassy ecosystems, celebrating ten years. *FOG slide presentation.*



About 140 species of moths (mostly undescribed) collected by Ted Edwards from grassland and woodland on two nights in January, from sites within 200 m, illustrating the biodiversity contained in these ecosystems. From FOG insect workshop 2003. Photo: Geoff Robertson

Volunteers: the nation depends on you

Geoff Robertson

Vice President, Friends of Grasslands. Email: geoffrobertson@iprimus.com.au

Introduction and key themes

A central question in conservation, and society more generally, is how to encourage greater participation in caring for society and country? This paper suggests a number of propositions that might help us address this question. First, a healthy society produces volunteers. Second, it is helpful to regard volunteering as unpaid work. Third, non-profit organisations (NPOs), which are usually run by volunteers, provide the bulk of volunteer employment. Fourth, NPOs need to be well organised and directed to be effective users of volunteer labour. Fifth, as employers, NPOs should clearly identify their employment needs. Sixth, volunteers should clearly consider what they are offering and seeking.

Who are volunteers?

According to the Australian Bureau of Statistics (2002), 34% of persons aged 18 and over undertake some form of voluntary work in a twelve months period. Voluntary work should not be confused with caring for sick relatives or child care which many Australians also undertake on an unpaid basis.

Not unexpectedly, most volunteering takes place in activities such as sport/hobby and recreational (12.1%), welfare/community (11.2), education/training/development (8.0), and religious (7.7). Only 2.1% reported environment/animal welfare activity. Other low scorers were health (2.3), emergency services (1.8), business/profession/union (2.1), arts/culture (2.3), and other (3.2).

Around 2% of males and females of all ages, from all geographic areas, and all income groups, and people with a disability, participate as volunteers in the environment/animal welfare category. However, participation is slightly higher for women, for rural areas (followed by inner region, with metropolitan last), in higher income groups (3% of highest income category), and the age group 45-54 (2.6%).

This is useful background when considering volunteering in the wider social context. Volunteering is one form of personal/social behaviour, as is employment, managing household resources, or caring, and all may contribute to such things as social cohesion, family and social support and people's ability to cope or care for our environment.

Community volunteers discussing land management at Old Cooma Common Grassland Reserve. Photo: Geoff Robertson

It occurs to me that national leaders should recognise the importance of volunteering as an indicator of a healthy society, and place stress on social and environmental involvement – they should lead by example. Honours should not be given in recognition for paid endeavours unless the recipient has also made a recognised contribution to the community.

A volunteer as an unpaid employee

In my view, we also need to sharpen our concept of volunteer. As a starting point, I think it is useful to simply define a volunteer as someone who works without remuneration or as an unpaid worker. 'Work' is a socially recognisable task (not simply defined by the volunteer) and worthy of remuneration. 'Work' may include unskilled and highly skilled tasks; and volunteers (especially those on boards of NPOs) may also be employers.

If voluntary work is unpaid employment, it follows that a person undertaking voluntary work is seeking rewards similar to those sought by someone seeking paid employment. Apart from the obvious exception of remuneration (in cash and kind), rewards include: conditions of work, using and developing skills and learning, making a worthwhile contribution, liking the boss, being the boss, being appreciated, career development, keeping the brain active, suitable hours and fitting in with family, social event/interaction, opportunity to travel, and working for an entity one respects.

NPOs as employers of volunteers

NPOs are the main employers of volunteers, and any discussion of volunteers needs to address how NPOs operate, and their effectiveness. An NPO is normally an unincorporated non-profit or not-for-profit organisation which is defined by law and its constitution. To understand an NPO, it is necessary to study its values and objectives, ethical standards, how and what services it provides to members, its stakeholders (who it influences/is influenced by), its members, its people (board of directors, CEO, staff and volunteers), and its resources.

A key issue is *governance,* i.e. how the organisation governs itself. This includes issues such as strategic planning and monitoring, quality of service delivery, and adherence to values, objectives and ethics.

An NPO offers a range of direct and indirect services to members. The former may include communication and information flow, advice, technical assistance and skills development. Indirect services are those not supplied to members, but which members consider a public good, such as marketing the products of the NPO, public education, targeting stakeholders and advocacy, on-ground work and research, and building infrastructure and networks.

To evaluate NPO effectiveness, one might ask a series of questions such as: Does the NPO have clearly stated values and objectives and adhere to them? Is it known and respected in the community? Are services comprehensive and of high quality? Do staff and volunteers have clearly defined roles and duties and are they enthusiastic? Is there a clearly articulated and effective strategic and work plan? Are the financial and human resources appropriately managed, and a risk management plan in place? Do board members understand the NPO and their role, turn up on time to meetings, prepare for and contribute effectively at meetings, and respect and support one another?

Recruiting, inducting and keeping volunteers

It follows that an effective organisation will have a strategy to recruit, train and keep volunteers. Like any good employer, it should: seek to fill gaps in its organisation, package the job to suit each individual's range of skills, have induction procedures that bring the volunteer up to speed quickly, negotiate clearly defined duties and responsibilities, have a job plan and timetable and seek advice from and provide direction to the volunteer. The organisation should also provide for career development (as appropriate) which can involve encouraging volunteers to move up and on, monitoring performance and providing rewards and recognition, and encouraging the volunteer to develop a self-development plan that addresses personal knowledge gaps and allows the volunteers to prepare for higher management.

A code of practice for volunteers

Too often neither the NPO nor the volunteer think about what it means to be a volunteer. This leads to undervaluing the work of volunteers and under-use of volunteer resources. It can be useful for organisations to develop volunteer codes of practice, manuals and procedures.

As a volunteer, I consider that the following propositions need to be affirmed in codes of practice:

- we regard volunteering as a privilege and responsibility of citizenship;
- we need the right balance between caring for ourselves, family, others and country;
- we should seek and take direction from others, and learn to work cooperatively;
- we need to respect the rights and views of others;
- we should not shy away from the belief in ourselves and providing leadership when required, and
- we need to equip ourselves to be good service providers and managers.

Some concluding remarks

Because of my experience in various NPOs and in various employment opportunities, my professional training and reading, and most importantly

through the input of many others, I have reflected deeply on what it means to be a volunteer. I would like to offer some personal conclusions:

- our first priority should be our own (and family's) survival, developing coping and other skills, and acquiring the resources to do so;
- however, a focus on acquiring resources should not become an obsession nor take a path that destroys society and country;
- our indigenous people provide an excellent example of caring for people and country;
- volunteering, while a social obligation, is freeing, empowering and rewarding work, and
- volunteering through effective NPOs builds community and participatory democracy.

Further reading and resources

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Volunteering Australia. This organisation publishes a wide variety of training resources and materials (such as various national standards for involving volunteers in not-for-profit organisations), and also the journal *Australian Journal on Volunteering*. See extensive website (www.volunteeringaustralia.org), which includes contact details for the numerous Volunteer Resource Centres around Australia. See also state-based organisations: Volunteering NSW (http://www.volunteering.com.au), Volunteering Queensland (http://www.volunteeringqueensland.org.au), Volunteering SA (http://www.volunteeringsa.org.au), Volunteering Tasmania (http://www.voltasinc.com), Volunteering Victoria (http://www.volunteeringvictoria.com.au) and Volunteering Western Australia (http://www.volunteeringwa.org.au).

Report from New Zealand Plant Conservation Network

Bec Stanley

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The New Zealand botanical community converged on Auckland in late November for the 4th annual NZPCN conference, this year shared with the NZ Botanical Society, to commemorate 100 years since the publication of NZ's first flora by Thomas Cheeseman. Over 170 amateur and professional botanists, plant enthusiasts, national conservation and local government staff and students attended this exhilarating three-day gathering. Papers were wide-ranging including sessions on pollination and conservation, but the focus was on plant systematics and the history of NZ's plant taxonomy.

The conference dinner, held at the Auckland Botanic Gardens after a tour through the threatened plant garden, included the announcement by the Minister of Conservation that the Network has a sponsor, MWH-New Zealand Ltd, to establish a national seed bank for New Zealand's threatened plants based at AgResearch (a Crown Research Institute). This partnership has been negotiated since the last NZPCN conference when Steve Alton from Kew's Millennium Seed Bank project presented a paper on long-term seed storage.

Rob Fenwick, a patron of the NZPCN, announced New Zealand's favourite plant, based on a web-based poll. The winner is the Chatham Island Christmas tree (*Brachyglottis huntii*) a nationally endangered small tree endemic to the Chatham Islands (an island archipelago east of the NZ mainland). Second place went to another island endemic, the Poor Knights lily (*Xeronema callistemon*), and third place to the handsome large-leaved coastal tree parapara (*Pisonia brunoniana*), which is restricted to islands because of the loss of breeding seabirds on the mainland.

The annual NZPCN Plant Conservation awards were presented during an evening tour of a Thomas Cheeseman exhibition at the Auckland Museum. There were winners in five categories celebrating achievements of local councils, community groups, schools, nurseries and individuals. The NZ Botanical Society also presented the Allan Mere award, an annual award for 'the most significant contribution to New Zealand Botany', to Peter de Lange. To conclude the evening Audrey Eagle's new edition of her two-volume *Trees and Shrubs of New Zealand* was launched. This marvellous book illustrates every tree and shrub in NZ painted by Audrey from real specimens collected by many of the botanists present at the launch.

The conference concluded with field trips to Rangitoto Island (NZ's most recent volcano) and Oratia Native Plant Nursery (a network sponsor).

View *Trilepidea*, the E-Newsletter of the New Zealand Plant Conservation Network:

October 2006
http://www.nzpcn.org.nz/documents/Trilepidea-061018.pdf

November 2006
http://www.nzpcn.org.nz/documents/Trilepidea-061115b.pdf

Research Roundup

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Information Resources and Useful Websites

CD/DVD Information Package: Threatened grassy vegetation communities of the Goulburn Broken Catchment

Department of Sustainability and Environment, Victoria

A CD/DVD Information Package titled 'Threatened grassy vegetation communities of the Goulburn Broken Catchment' was launched in September 2006 during 'Biodiversity Month'.

The Information Package contains an interactive CD-Rom of technical information for land managers of native vegetation on public and private land. Three vegetation communities were targeted specifically (Northern Plains Grassland, Grey Box-Buloke Grassy Woodland and Box-Gum Grassy Woodland and derived grasslands). These communities are threatened in the Goulburn Broken Catchment and are listed under State and/or Federal Government legislation including EPBC and FFG Acts.

The CD-Rom includes community fact sheets, site assessments, aerial photography, mapped information and a literature review of relevant scientific and technical papers. An added bonus is a DVD of two videos titled 'Treasures of our grassy woodland' and 'Native grasslands of the Victorian Riverina' which were previously released by the North Central Catchment Management Authority.

The Information Package has been distributed to Local Government and Agency staff, Landcare Groups and Facilitators and Parks Victoria in the Goulburn Broken. Also, Local Government planning staff have been provided with GIS data to update their planning systems.

The project was funded by the Natural Heritage Trust through the Goulburn Broken Catchment Authority. Limited copies of the Information Package are available through the Department of Sustainability and Environment.

Information provided by: Gaye Furphy, Department of Sustainability and Environment, Benalla, Vic. Email: gayefurphy@dse.vic.gov.au

EcoRamblings

To subscribe, send email with SUBSCRIBE in subject line to scropper@botanicus-aust.com.au

EcoRamblings is a new electronic newsletter for people that are required to address or manage flora, fauna, vegetation or natural ecosystems in Australia. It is produced by Simon Cropper from Botanicus Australia. Articles are succinct, and include numerous links to information on the internet. The first issue includes titles such as: *Site stratification, an essential component of a flora survey, Heat stress in outdoor workers* and *The demise of the ephemeral wetlands of the basalt plains.*

Publications from Land and Water Australia

http://www.lwa.gov.au/products.asp

Land and Water Australia describes its core business as 'a research investigator, gaining knowledge for managing Australian landscapes to achieve the sustainable management and use of Australia's natural resources'. Land and Water Australia produces more than 600 publications, such as fact sheets, posters, reports, books and brochures. Many titles can be downloaded free from their website, where there is a catalogue that can be searched by various categories. Examples of available publications include the *User Guide - Australian Natural Resources Atlas and Data Library,* the fact sheet *Vegetation restoration and landscape design for enhanced biodiversity conservation,* the poster *Australia's Native Vegetation from rainforest to spinifex,* and the magazine *Thinking Bush.*

ANPC Workshops

Workshop on rehabilitation and management of disturbed native vegetation

14-15 March 2007

Coffs Ex-Services Club, Coffs Harbour, NSW

Are you involved in the rehabilitation of native vegetation? Does your work-site include native vegetation that you need to manage or rehabilitate? Do you participate in local rehabilitation projects? Are you interested in reversing the decline of native plant communities in your area? Then this workshop is for you!

Workshop focus

- The knowledge and skills required to undertake ecological rehabilitation and management of disturbed native vegetation.

Themes include

- the ecological principles essential to planning a rehabilitation project;
- understanding the task (the goal for the site, planning, resources, assessing site and vegetation condition, issues such as soil health, provenance, impacts on coastal environments, monitoring and ongoing management, local issues), and
- applying ecological principles to rehabilitation projects (local case studies, site visits, demonstration and trialling of techniques).

Workshop fee (includes catering, field trip, Plant Conservation Techniques manual on CD & GST)

ANPC member: $175 *Concession (ANPC member): $85
Non-member: $195 *Concession (non-member): $105

* Concession for volunteer community group members, full-time students, pensioners.

Further information: the flyer and registration form are on the ANPC website http://www.anpc.asn.au/WorkshopRegistration2007.html or available on request from the ANPC. When finalised, the program will be posted on the website.

Registrations close: Friday 2 March 2007

Accreditation: Participation in ANPC workshops can contribute to qualifications in the Conservation and Land Management Training Package. Cost = $25 (incl GST). More information available on request (and on ANPC website http://www.anpc.asn.au/course1.html#Courseaccreditation).

Environmental TRUST

This workshop is subsidised by the NSW Government through its Environmental Trust.

ANPC National Forum – April 2007
What lies beneath? The role of soil biota in the health and rehabilitation of native vegetation.

17-19 April 2007

CSIRO Discovery Theatre, Black Mountain, Acton, Canberra, ACT.

Did you know that:

- Most Australian plants grow symbiotically with mycorrhizal fungi?
- Healthy soil crusts protect against drought and weeds?
- Paddock soils contain many fewer mycorrhizae than adjacent woodland?

The next bold step in native vegetation rehabilitation

This national forum will provide an opportunity for sharing the latest research on the key roles of soil organisms in ecosystem function. We will attempt to come to grips with how this knowledge can be applied in native vegetation rehabilitation practice.

The primary focus will be on the hidden and often-overlooked flora: mosses, liverworts, algae, fungi and lichens.

The forum will include:

- presentations on the diversity of soil biota and their role in ecosystem function;
- workshops including identification of fungi, lichens and mosses;
- panel discussions on application to native vegetation rehabilitation, and
- field visits demonstrating techniques and practical application.

Registration: you can attend the full 3-day forum OR selected days. Fee also includes catering, field costs & GST.

Full forum: $330 or daily fee of $110
ANPC Member (10% discount): full forum: $300 or daily fee of $100

Further information: is on the ANPC website at http://www.anpc.asn.au/conferences.html or available on request from the ANPC. The forum flyer is at http://www.anpc.asn.au/pdffiles/ANPCForumFlyer_FINAL.pdf (and see back cover of this issue). The registration form and program will be posted on the website when finalised.

Natural Heritage Trust
Helping Communities Helping Australia
A Commonwealth Government Initiative

AUSTRALIAN Government envirofund

The workshops and field components of this forum are supported by the Australian Government's Envirofund.

Conferences and Workshops

Southern Connection Congress

21-25 January 2007, University of Adelaide, South Australia

Southern Connection is a group of scientists from all continents who study aspects of biology and earth history of the southern continents. The conference has an arid-zone theme, plus a field trip to Kangaroo Island.

Symposia include:

- Aridification on the four southern continents: Australia, South America, Africa and Antarctica;
- Southern temperate marine ecosystems;
- Goodbye Gondwana: a fresh perspective on the roles of vicariance and dispersal;
- Methodologies for studying southern urban ecosystems, and
- Understanding the impact of invasive species.

See: http://events.lincoln.ac.nz/southern/events.htm, or email Glenn Stewart: stewartg@lincoln.ac.nz

3rd Global Botanic Gardens Congress 'Building a Sustainable Future: the Role of Botanic Gardens'

16-20 April 2007, Wuhan, China

The Global Botanic Gardens Conference is held every three years. The 2007 Conference marks the 20th anniversary of Botanic Gardens Conservation International (BGCI) and will provide a global forum for the botanic garden community to share their knowledge, experience, practice and research.

Further information: http://www.3gbgc.com

FUNGIMAP IV Conference

1-4 June 2007, Natural Bridge, SE Queensland

Fungimap is a community group dedicated to conserving Australian fungi and improving knowledge about them. Activities include a fungi mapping scheme. The Conference will consist of a day of talks, followed by three days of fungal forays and workshops, including a trip to Lamington National Park. Activities are tailored for all levels of expertise, from beginners to experts.

Contact: fungimap@rbg.vic.gov.au

Conserv-vision, the next 50 years: an international conference on conservation of biodiversity and historic resources

4-7 July 2007, University of Waikato, Hamilton, New Zealand

This conference celebrates 20 years of integrated conservation management by the New Zealand Department of Conservation.

The goals of the conference are to bring together practitioners, scientists, policy-makers and conservation advocates from New Zealand and elsewhere to:

- consider future challenges for conservation agencies and how existing models might be strengthened or adapted to meet them;
- review and evaluate achievements of the past 20 years of conservation management in NZ, and
- assess ways in which conservation agencies might best achieve their goals in 2050 and beyond.

See: http://www.waikato.ac.nz/wfass/Conserv-Vision/

Australasian Section of the Society for Conservation Biology

10-13 July 2007, University of New South Wales, Sydney

An inaugural Regional Meeting of Conservation Scientists, organised by the Australasian Section of the Society for Conservation Biology, will be held on the topic 'The Biodiversity Extinction Crisis, a Pacific and Australasian response'.

Special challenges in the Pacific and Australasian region include: island ecology, rising sea levels, changing rainfall, and land and water degradation. These issues are overlaid by the general problems of habitat loss and fragmentation, invasive species, pollution and over-harvesting. The conference will identify major problems for biodiversity conservation in the region, look for existing and potential solutions and establish links to global biodiversity initiatives.

There will be five major themes:

- Regional challenges (particular issues for our part of the world);
- Managing threatening processes of universal importance;
- Case studies of conservation in action, including biodiversity monitoring and assessment;
- Conservation science and policy; and
- Conservation science and the community (NGOs, indigenous people).

9th International Conference on the Ecology and Management of Alien Plant Invasions

17-21 September 2007

Hyatt Regency Hotel, Perth, Western Australia

Further information: http://www.congresswest.com.au/emapi9

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ANPC acknowledges the support of the following corporate members

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Coffs Harbour City Council, New South Wales
Department for Environment & Heritage, Science and Conservation, South Australia
Department of Environment & Conservation, New South Wales
Department of Environment and Conservation, Western Australia
Department of Natural Resources, Environment and The Arts (NRETA), Northern Territory
Department of Sustainability and Environment, Warrnambool, Victoria
Ensis Genetics, Australian Tree Seed Centre, ACT
Institute of Food and Land Resources, Victoria
Redland Shire Council, Queensland
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Sydney Olympic Park Authority
Warringah Council, New South Wales
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NATIONAL FORUM - APRIL 2007

What lies beneath? The role of soil biota in the health and rehabilitation of native vegetation

Tuesday 17 – Thursday 19 April 2007

Venue: CSIRO Discovery Theatre, Clunies Ross Street, Acton, ACT.

Did you know that:

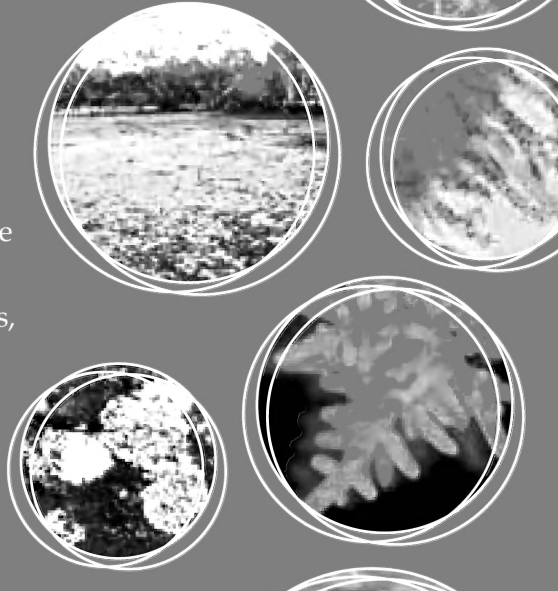
- Most Australian plants grow symbiotically with mycorrhizal fungi?
- Healthy soil crusts protect against drought and weeds?
- Paddock soils contain many fewer mycorrhizae than adjacent woodland?

The next bold step in native vegetation rehabilitation

This national forum will provide an opportunity for sharing the latest research on the key roles of soil organisms in ecosystem function. We will attempt to come to grips with how this knowledge can be applied in native vegetation rehabilitation practice.

The primary focus will be on the hidden and often-overlooked flora: mosses, liverworts, algae, fungi and lichens. These organisms are important in ecosystem functioning (for example through formation of biotic soil crusts and as mycorrhizal partners of plants).

Practitioners will demonstrate identification techniques and applications to rehabilitation practice, share knowledge and skills gained from experience, and identify areas of research needed to fill knowledge gaps.



The forum will include:

- presentations on the diversity of soil biota and their role in ecosystem function
- workshops including identification of fungi, lichens and mosses
- panel discussions on application to native vegetation rehabilitation
- field visits demonstrating techniques and practical application.

National experts will be presenting, including

Neale Bougher, Andrew Claridge, Matt Colloff, David Eldridge, Tom May, Peter McGee, Peter Thrall.

Registration: you can attend the full 3-day forum OR selected days.

Registration fee also includes catering, field costs & GST

Full forum: $330 or daily fee of $110

ANPC Member (10% discount): full forum: $300 or daily fee of $100

Registration forms and programs will be posted on the ANPC website http://www.anpc.asn.au/conferences.html

Natural Heritage Trust

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Photos top to bottom: Spore of *Glomus*, a mycorrhizal fungus growing within plant roots; photo: Peter McGee. Moss leaflets under microscope; photo: Cassia Read. *Dermocybe splendida*, a mycorrhizal fungus of eucalypt forests; photo: Simon Lewis. Mycorrhizal fungal hyphae within Wollemi Pine root cells; photo: Peter McGee. Biotic soil crust; photo: Cassia Read. Cystidia of the fruiting body of the fungus *Aleurodiscus*; photo: Neale Bougher. Sheath of ectomycorrhizal fungus on *Nothofagus* rootlet; photo: Christopher Dunk. Biotic soil crust with lichens; photo: Cassia Read. Seedlings inoculated with mycorrhizal fungi; uninoculated seedlings failed; photo: Peter McGee. Direct-seeding trial to test if salt-tolerant native rhizobia improve establishment of acacias on saline soils; photo: Peter Thrall.

Australasian Plant Conservation

BULLETIN OF THE AUSTRALIAN NETWORK FOR PLANT CONSERVATION

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